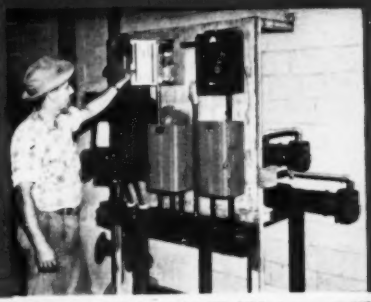
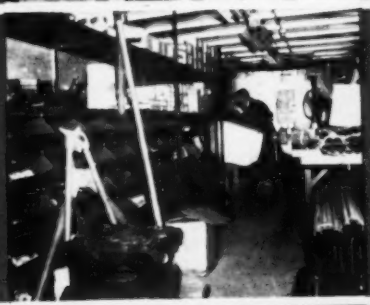
DECEMBER 1952
PRICE 25 CENTS

ELECTRICAL CONSTRUCTION AND MAINTENANCE

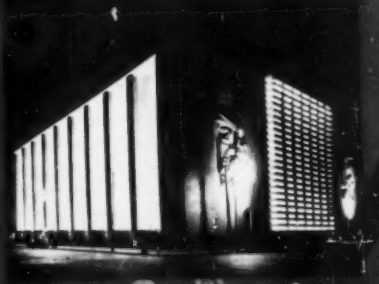
WITH ELECTRICAL CONTRACTING



CONTROL for fuel heating at Philadelphia airport.



TRAILER provides field office, shop and stock room for Chicago contractors.



LIGHT AND ARCHITECTURE dress up San Francisco utility substation.

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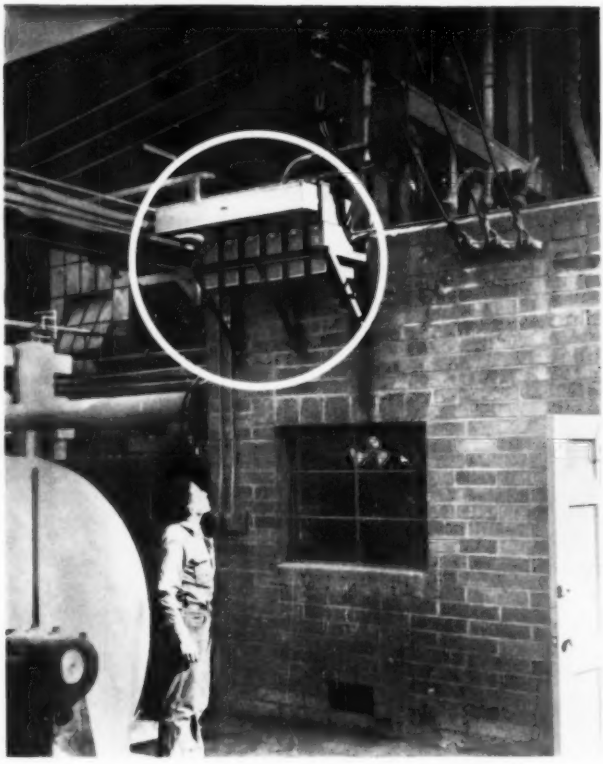


Prevents transformer "burnouts." This 90 kvar, 3 phase, 60-cycle, 460-volt G-E capacitor equipment (circled) helps relieve transformer overloading. Solomon Fingold, Montrose Chemical's electrician, surveys it appreciatively.

Overloaded transformers relieved with G-E Capacitors

Montrose Chemical Corp. of Calif. prevents transformer "burnouts," saves $1800 a year on power costs . . . with $1451 investment.

Rapid postwar expansion put a heavy overload on the transformers that supply power to the Montrose Chemical Corp. of California, located in Los Angeles. Recently, when the overload became critical, the Company sought help. An investigation showed that the plant's power factor was down to 76%—so General Electric engineers recommended the installation of 180 kvar of General Electric capacitors at a cost of $1451.

Capacitors improve power factor. Once installed, the capacitors brought the plant's power factor up to better than 97%. This relieved transformer overloading by reducing line current. And since Montrose Chemical had a power-factor clause in its power contract, it also cut power costs by $1800 a year. Thus, the saving on power costs alone will pay for the equipment in less than ten months! *And these savings will go on indefinitely.*

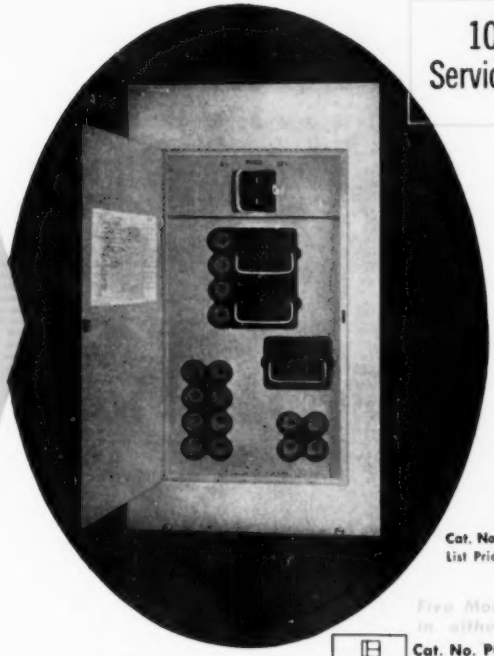
Capacitors provide other benefits, too! Besides releasing transformer capacity, capacitors often permit your present distribution system to carry 20 to 30% more load without added equipment. Where voltage drop is a problem, capacitors can also provide the needed voltage boost inexpensively.

They often hold key to lower power costs. If your power factor is below 85% and if there is a power-factor or kva-demand clause in your power contract, chances are you, too, can make worthwhile savings on your power costs by installing capacitors. For additional information, consult your local G-E Apparatus Sales Office or authorized G-E agent or distributor. Or write to Section 407-210 for Booklet GEA-5632—"How to Use Capacitors to Reduce Power Costs and Gain System Capacity." General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

ANOTHER NEW Murray PRODUCT

100 Ampere Service Equipment



Cat. No. PC316A
List Price – **$74.00**

HERE'S A "Packaged" SOLUTION TO INCREASING LOADS

Murray's "Combination" units will solve your main switch and distribution panel problems—

1 THEY PROVIDE BOTH SERVICE ENTRANCE AND BRANCH DISTRIBUTION IN ONE UNIT.

These Murray "Combination" service entrance and branch distribution units provide 100 Ampere main circuit breaker, fusible range and water heater pullouts, lighting and appliance plug fuse branch circuits – with or without a dryer pullout!

2 THEY PROVIDE FOR GROWING ELECTRICAL LOADS.

Any one of these five compact units offers a packaged solution to increasing loads. They are ideal for small commercial and large residential installations.

3 THEY SAVE TIME AND MONEY IN INSTALLATION.

Murray "Combination" units will save you time and money all along the line. Just one unit to *buy* – just one unit to *install* – just one unit to *wire*!

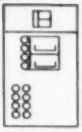
Factory bussing makes these units easy to wire. There's plenty of wiring room and all K. O's are conveniently located. Hook-on cover uses only two screws. Compact! Only 12-⅞ inches wide, designed to fit between building studs.

4 THEY GIVE DEPENDABLE CIRCUIT PROTECTION AT ALL TIMES.

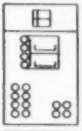
Fully magnetic circuit breaker main consists of two independent trip, 1 pole, 100 Ampere 120/240 volt AC fully magnetic circuit breakers. Carries full rated load continuously. Handle bar permits simultaneous manual tripping to "off".

Murray's well-known fusible pull-out construction provides positive electrical contact. One piece fuse clip and blade prevents overheating.

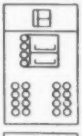
Five Models to Choose from in either surface or flush.



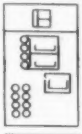
Cat. No. PC212A
100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
12 plug fuse branch circuits
List Price – **$57.00**



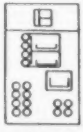
Cat. No. PC216A
100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
16 plug fuse branch circuits
List Price – **$64.00**



Cat. No. PC220A
100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
20 plug fuse branch circuits
List Price – **$71.00**



Cat. No. PC312A
100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
30 Ampere dryer fusible pullout
12 plug fuse branch circuits
List Price – **$67.00**



Cat. No. PC316A
100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
30 Ampere dryer fusible pullout
16 plug fuse branch circuits
List Price – **$74.00**

Murray®

MURRAY MANUFACTURING CORPORATION
1250 ATLANTIC AVENUE · BROOKLYN 16, N.Y.

Service Entrance & Meter Equipment • Fully Magnetic Circuit Breakers • Switches (Types A, C and D)
Current Limiting Reactors • Crows' Nest Aerial Ladders

AIR COOLING Cuts Cleaning Costs ...Boosts Lamp Life...

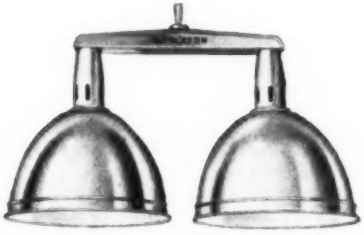
APPLETON VENTED INDUSTRIAL LIGHTING

Now APPLETON Industrial Lighting for high bay interiors is available with a new cooling feature that cuts deeply into your lighting costs.

Air vents in the necks of these durable fixtures permit air to circulate freely through the full depth of the reflector and along the neck of the lamp. Dirt and dust keep on moving upward through the vents. Deposits on reflecting surfaces and lamps are minimized. Operating temperatures are held at lower levels. Result: Greater lighting efficiency, longer lamp life and lower cleaning costs.

APPLETON Vented Industrial Lighting Fixtures are available with either porcelain enamel or Alzac Aluminum finish, single or twin mounting, and for use with either mercury vapor or incandescent lamps.

For lighting fixtures that meet every industrial requirement—including hazardous locations—specify APPLETON, The Standard For Better Lighting.



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ELECTRICAL CONSTRUCTION AND MAINTENANCE

Published for electrical contractors, industrial electricians, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management, in the field of electrical construction and maintenance.

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See XO

CIRCUIT BREAKER

1 to 32 Circuits

Only six devices form the basic XO line in general purpose enclosures.

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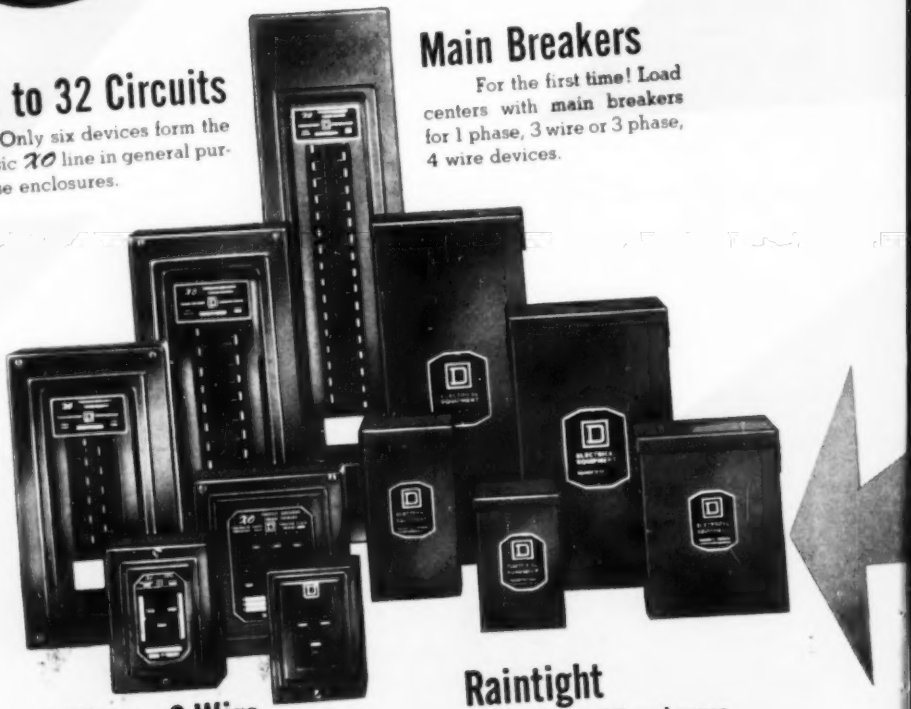
For the first time! Load centers with main breakers for 1 phase, 3 wire or 3 phase, 4 wire devices.



1 Phase, 3 Wire
3 Phase, 4 Wire

To meet modern trends in distribution. Both raintight and general purpose.

Raintight

All enclosures are Underwriters' approved. Available with or without provision for the popular interchangeable hubs.

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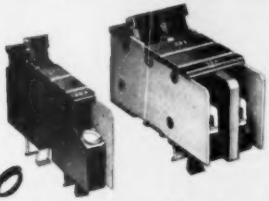
It's the Most Complete LOAD CENTER LINE!



XO

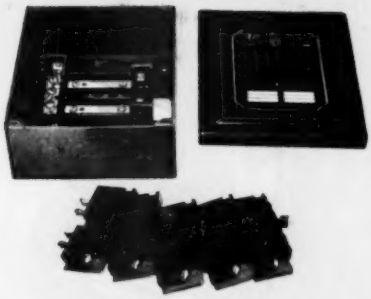
Plug-In Units have ALL the Features

1. **Quick-Make, Quick-Break** operation at no extra cost.

2. **Ambient Compensation** ends nuisance tripping. No extra cost.

3. **Thermal-Magnetic** for complete 2-way protection against both moderate and heavy overloads.

4. **Non-Interchangeable feature** prevents higher capacity 30, 40, 50 ampere sizes from being substituted for 15 and 20 ampere breakers. Discourages dangerous tampering.

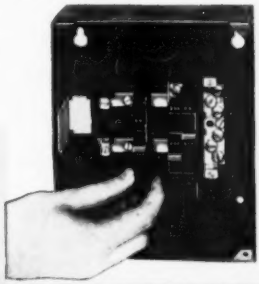


Off-the-Shelf Delivery

Just 3 components simplify selling and stocking. Box with interior, cover, and plug-in breakers. Breakers conveniently packed in individual boxes and multi-packed in cartons. All the sales features—highest quality, no cost premium, immediate delivery.

"Plus" Applications

The XO solves specific water heater, switched neutral and other split bus problems—in many cases with standard components.



So Easy to Install

Breaker units simply "plug-in" on bus bars. Load terminals out in front for easy wiring. Straight wire terminal connections—no looping necessary.

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"We equip all our fluorescent fixtures with Certified Ballasts because we find our distributors, the contractors who make the installation and the users all are more satisfied with results when Certified Ballasts are installed," says A. F. Wakefield, president of The F. W. Wakefield Brass Company, Vermilion, Ohio.

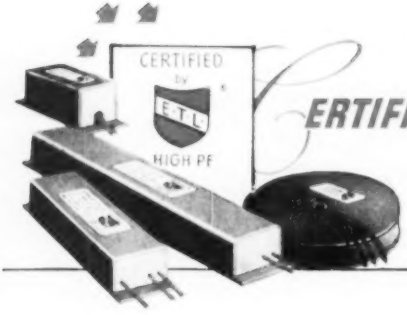
His conviction is shared by many other manufacturers who have learned that CERTIFIED BALLASTS assure—

Full Lamp Life **Rated Light Output** **Maximum Ballast Life**

CERTIFIED BALLASTS are made to precise specifications, then tested by Electrical Testing Laboratories, Inc., which certifies they conform to these high standards.

Write for complete information on the types of CERTIFIED BALLASTS available from each participating manufacturer.

Participation in the CERTIFIED BALLAST program is open to any manufacturer who complies with the requirements of CERTIFIED BALLAST MANUFACTURERS.



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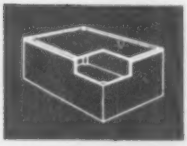
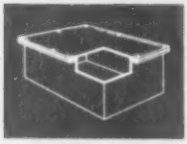
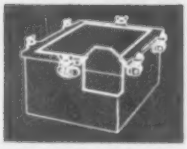


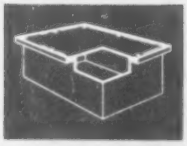
UNFLANGED BOXES
H1200 Type
164 sizes
from 4 x 2 x 2 to 48 x 36 x 17



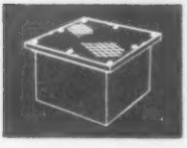
FLAT FLANGED BOXES
H8000 Type
87 sizes
from 4 x 4 x 3 to 36 x 36 x 12



HINGED COVER BOXES
H3200 Type
128 sizes
from 5 x 5 x 3 to 36 x 36 x 12



FLANGED RECESSED COVER BOXES
H7000 Type
51 sizes
from 4 x 4 x 2 to 30 x 24 x 12



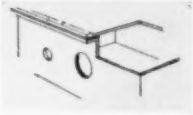
CHECKERED COVER SIDEWALK BOXES
H5800 Type
53 sizes
from 6 x 6 x 4 to 36 x 24 x 14

STANDARD BOXES are of strong, dense cast iron—hot dip galvanized for long service and attractive appearance. Weatherproof construction—rubber-gasketed closure prevents entry of rain, snow, sleet or dust under normal conditions.

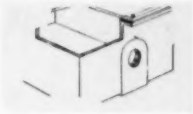
CUSTOM VARIATIONS

You can specify any of these modifications in standard BOXES by HOPE —have them factory-made at moderate cost—and get prompt delivery.

DRILLING—
or drilling and tapping—
at conduit entrances

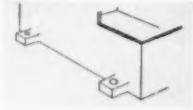


BOSSES—
to provide extra thickness
for five-thread conduit entrances.
Drilled and tapped to specification
if desired

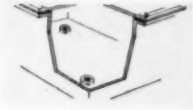


SPECIAL GASKETS —
Neoprene for fungus resistance in hot, humid climates • pure gum for extreme softness and resistance to special acids • Vellumoid for resistance to oils and fats • graphite-free compressed asbestos for installation near boilers or steam pipes

MOUNTING LUGS—
drilled for any desired
bolt size



INTERIOR MOUNTING BUTTONS—
—tapped blind
to specified centers



AND . . . you can order these custom modifications, as well as standard BOXES by HOPE, conveniently and quickly, through your local electrical distributor.

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ELECTRICAL PRODUCTS CO., INC.

338 Wilson Avenue, Newark 5, N. J., Mitchell 2-4426

EXPLOSION HOUSINGS BY HOPE

have been extensively used in Class 1, Groups C and D hazardous locations, such as chemical, petroleum and powder plants, pump rooms and paint plants.

GET THE FULL STORY ON BOXES BY HOPE —
WRITE ON COMPANY LETTERHEAD FOR CATALOG

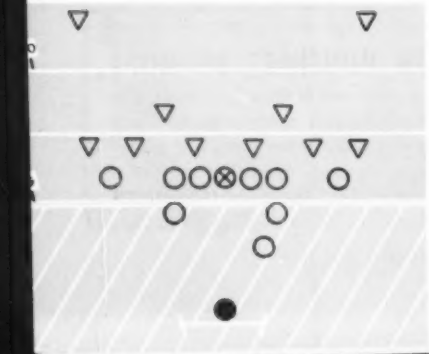
EXPERTS AT WORK,

EXPERTS AT PLAY,

ALL AGREE:

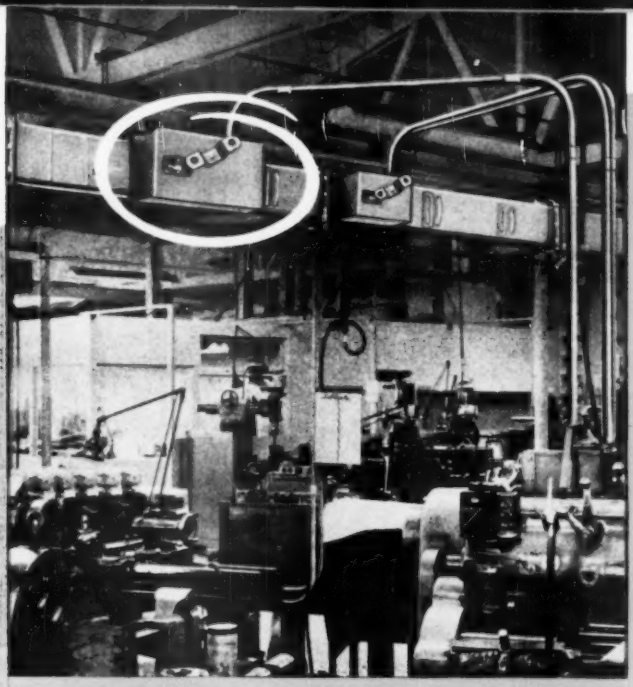
THERE'S ONE BEST WAY!

You're in trouble. You've lost yardage on three plays. Your back's on your own goal line. Last down coming up. You have to kick—and make it good. There are several plans of action open to you, but one way is best. Do you know what it is?



Football experts agree the kicking area must be protected at all costs. With the kicker in the end zone, the five middle linemen "hold the fort". Ends cover ends. Two backs protect on the kicking side, the other back on the punter's "off" side. Covering the punt must remain a secondary consideration until the kick is away. There is nothing to gain in covering a punt that doesn't get off.

Electrical experts agree a plant's vital power, lighting, and distribution circuits must be protected at all costs. The one best way is to install circuit breakers.



Bus ducts are a plant's vital power arteries. Failure to protect them properly against short circuits or overloads can result in costly outages, production breakdowns—even a disastrous fire.

Experts agree the best way to achieve this protection is to install modern, dependable I-T-E circuit breakers. Breakers can be located at any convenient point in the bus duct run, providing complete protection for branch and feeder circuits. In this way, wherever there's trouble, the outage is confined to the individual protective breaker. The rest of the power distribution system—other production—is unaffected.

Experts agree on I-T-E because:

(1) Thermal-magnetic trip action provides dual protection—protection against both short circuits and overloads.

(2) Sealed case guards against tampering with precise factory calibration.

(3) Installation is easy—breakers simply plug-connect to bus.

(4) Long life is assured. There's no replacement of parts.

(5) Heavy-duty, industrial type I-T-E circuit breakers are built to withstand toughest plant conditions.

Protect your plant the expert way. Install I-T-E Molded Case Circuit Breakers on all your vital power arteries.

I-T-E 'F' frame circuit breakers, ceiling-mounted on bus duct run, assure positive protection and quick restoration of service in this industrial plant.

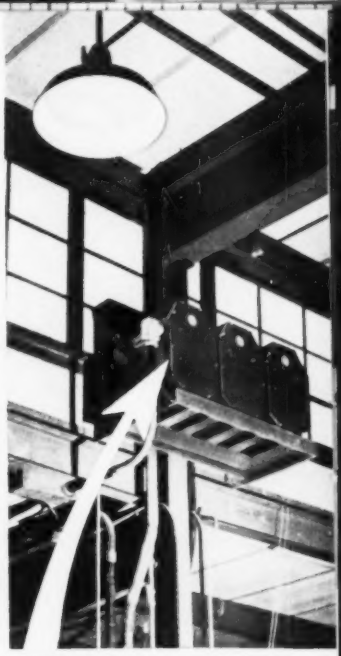
FOR FULL DETAILS—on complete line of I-T-E Molded Case Circuit Breakers—from 10 to 600 amperes, up to 600 volts a-c, 250 volts d-c—send for your copy of *Bulletin 5108-D* today.

I-T-E

MOLDED CASE CIRCUIT BREAKERS

I-T-E CIRCUIT BREAKER CO. • 19th and HAMILTON STREETS • PHILADELPHIA 30, PA.

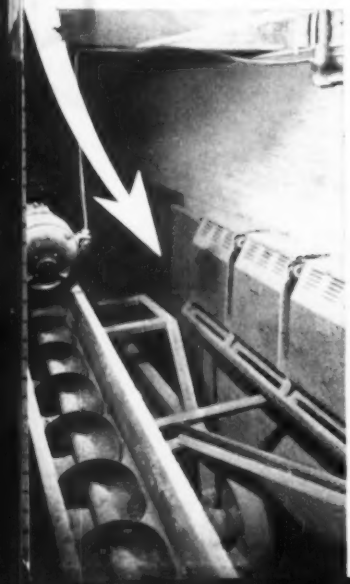
POWER for machines, portable tools and other 115 or 230 volt loads can be supplied at substantial savings when voltage is stepped down right at the load. Here Behr-Manning Corp., abrasives manufacturer, serves its G-E Metallic Rectifiers with G-E Type M Transformers.



LIGHTING demands correct voltage for top efficiency. Behr-Manning assures it with G-E Type D Transformers.

Stretch the power dollars in your plant with these G-E Dry-Type Transformers

INDOOR loads use Type D's .25 kva and above. These at Producers' Cotton Oil Co. serve lighting circuits.



Throughout industry, wherever machines, lighting or portable tools require voltage changes, you'll find G-E Dry-Type Transformers making power dollars go further.

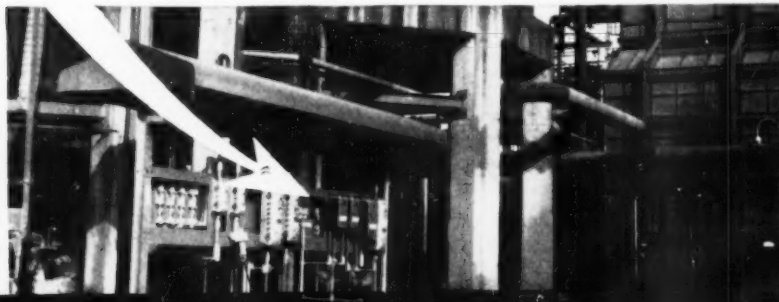
By stepping the voltage down to utilization level *right at the load*, they cut line losses and eliminate long, expensive secondary feeders. This means reduced wiring costs, higher installation efficiency—and often lower power costs.

Quiet in operation, lightweight G-E Dry-Type Transformers require practically no inspection or maintenance. Easy to install, they can be mounted on wall brackets or columns to save floor space. Many larger sizes have solderless connectors to simplify installation.

For additional information on G-E Dry-Type Transformers, call your authorized G-E distributor, today. Or write for bulletin GEC-868A, *Section 411-105, General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

OUTDOOR loads such as this explosion-proof control center at catalytic cracking tower of Phillips Petroleum Company in Borger, Texas, can be served by G-E Type M Transformers. These versatile units are available in .25 thru 15 kva ratings for outdoor or indoor service.



PARKWAY CABLE

Save the cost of duct systems!...with the most dependable Parkway Cable you can buy!

ROEBLING'S research staff is continually working at the job of product development. Our manufacturing facilities and techniques are constantly improved. That's why our Parkway Cable for distribution and general power supply circuits is today even more dependable than ever before.

Roebling Parkway Cable saves money right from the start because it is buried directly in a shallow, low-cost trench. It is made in single and multiple conductor – solid or stranded – in a range from 600 to 5,000 volts . . . furnished with metallic armor or a non-metallic *Roeprene* sheath, depending on the physical protection required. Types that pass all C.A.A. requirements for Specification No. L-824 for airport lighting are also available.

Large quantities of Roebling's full line of electrical wires and cables are needed in the rearmament program. We and our distributors will do everything possible, however, to meet your requirements. **John A. Roebling's Sons Company, Trenton 2, N. J.**

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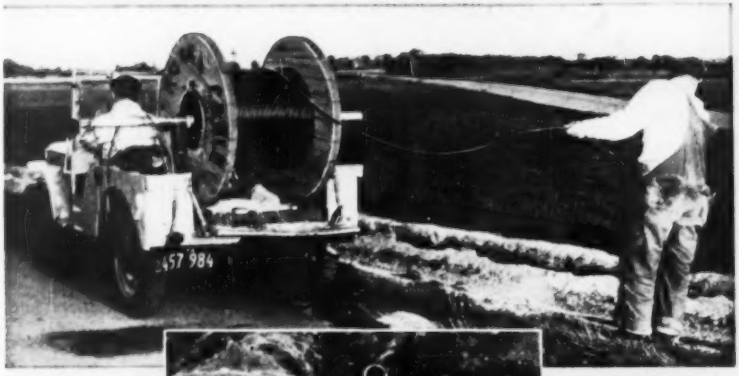
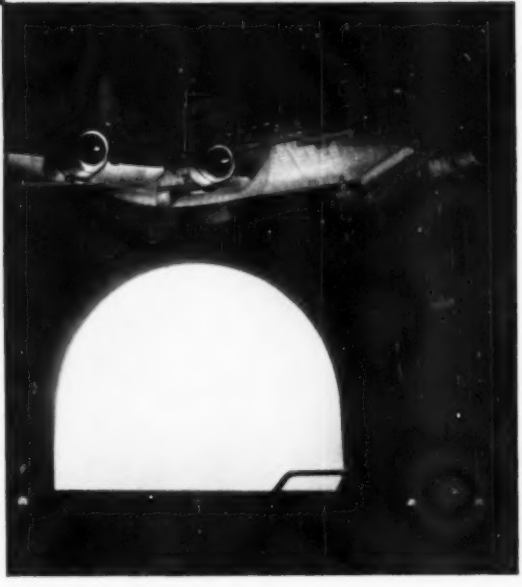
ATLANTA, 934 AVON AVE. • BOSTON, 51 SLEEPER ST. & 5 PITTSBURGH ST. • CHICAGO, 5525 W. ROOSEVELT RD. • CINCINNATI, 3253 FREDONIA AVE. • CLEVELAND, 19225 LAKEWOOD HEIGHTS BLVD. • DENVER, 4801 JACKSON ST. • DETROIT, 815 FISHER BLDG. • HOUSTON, 6216 NAVIGATION BLVD. • LOS ANGELES, 5340 E. HARBOR ST. & 120 S. HEWITT ST. • NEW YORK, 19 RECTOR ST. • OSSINING, TEXAS, 1920 E. 2ND ST. • PHILADELPHIA, 230 VINE ST. • PITTSBURGH, 1901 CLARK BLDG. • ROCHESTER, 1 FLINT ST. • SAN FRANCISCO, 1740 17TH ST. • SEATTLE, 900 1ST AVE. S. • ST. LOUIS, 2001 DELMAR BLVD. • TULSA, 321 N. CHEYENNE ST. • EXPORT SALES OFFICE, TRENTON 2, NEW JERSEY



Upper left—Smooth finish and flexibility of RoMarine-RoPrene and RoZone-RoPrene lighting cables make working and pulling easier. Clean stripping insulations facilitate splicing.

Lower left—High-quality heat and moisture-resistant insulations plus over-all protective Neoprene compound sheath permit these cables to be plowed direct in earth.

Upper right—Base for boundary light—terminations are quick, easy with simple manual connections or with pre-applied molded terminals.



Lower right—Boundary lights, the guardians of safe night landings, require dependable cables —RoMarine-RoPrene and RoZone-RoPrene.

You're sure you're right with

RoMarine - RoPrene® (C.A.A. TYPE A)
and RoZone - RoPrene® (C.A.A. TYPE B)

Airport Lighting Cables

THE ESTABLISHED LEADERS IN THE FIELD

In selecting or recommending cables for airport lighting it pays to *be sure* that you are *right*. And you *can be sure* with RoMarine-RoPrene and RoZone-RoPrene airport lighting cables. They are the established leaders in the field. Both were the first cable constructions to be fully approved by the Civil Aeronautics Administration for airport lighting and control circuits under specification L-824.

This approval resulted from the high quality of Rome's cable constructions as attested by independent laboratory tests.

Protects against heat, moisture

Ro-Marine-RoPrene is approved as Type A, Style RR, covering single and multiple conductors for 600, 3000 and 5000 volt services. Exceptional protection against heat and moisture results from its RoMarine (specially compounded rubber) insulation. An over-all protective Ro-Prene (Neoprene compound) sheath resists heat, moisture, acids, alkalies and sunlight.

RoZone-RoPrene is approved as Type B, Style ROR, covering 3000 and 5000 volt ratings. Its superior oil-base insulation is the ultimate in quality. And it has the same all-resistant RoPrene sheath.

Save money in several ways

Both cables are recommended for inventory reduction, two-way installation. They can be plowed direct in earth, or placed in underground ducts or conduits. They cut labor costs and installation time, too. Lighter weight, smoother finish and flexibility make them easier to work and pull. Insulation strips clean for rapid splicing. Termination can be made with simple manual connections, eliminating pot heads or stress cones.

Get the facts on RoMarine-RoPrene and RoZone-RoPrene . . . the airport lighting cables that you can install with confidence. Mail the coupon below today.

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Utica—Mather, Evans & Diehl Co.
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Greensboro—Southern Elec. Serv. Co.
Rocky Mount—Hammond Elec. Co.

OHIO
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Akron—A C Supply Co.
Toledo—Romanoff Elec. Motor Serv.
Youngstown—Winkle Electric Co.

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Oklahoma City—Southwest Elec. Co.
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Pittsburgh—Penn. Elec. Coil Corp.
York—Industrial Electric Company

SOUTH CAROLINA
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Spartanburg—Southern Elec. Serv. Co.

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ALLIS-CHALMERS CERTIFIED SERVICE SHOPS are independent service shops which have met rigid standards for ability, experience, equipment and business integrity. They use factory approved methods and parts and do your work promptly at a fair price.

Of course, Allis-Chalmers Certified Service Shops give good service on any electrical equipment, of any make. Tear out this ad and save it, or write the name of the A-C Certified Service Shop nearest you in your address book. Allis-Chalmers, Milwaukee 1, Wisconsin. A-3864

Texrope and Vari-Pitch are Allis-Chalmers trademarks.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

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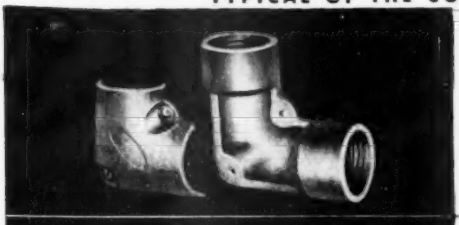
ALLIS-CHALMERS

FOR CORNER PULL-IN ELBOWS, 3-PIECE CONDUIT COUPLINGS, PIPE STRAPS—CLAMP BACKS—NEST BACKS

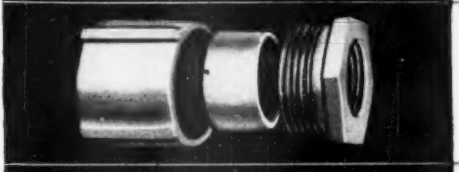
GEDNEY *ALWAYS!*

NATURALLY you want to cut installation time and costs. And you'll do it easily with Gedney Fittings, for these fittings are accurately machined and threaded, smooth finished, individually inspected to ensure top quality. What's more, Gedney Fittings are made of unbreakable malleable iron. For best profits, order Gedney always!

TYPICAL OF THE COMPLETE GEDNEY LINE ARE:

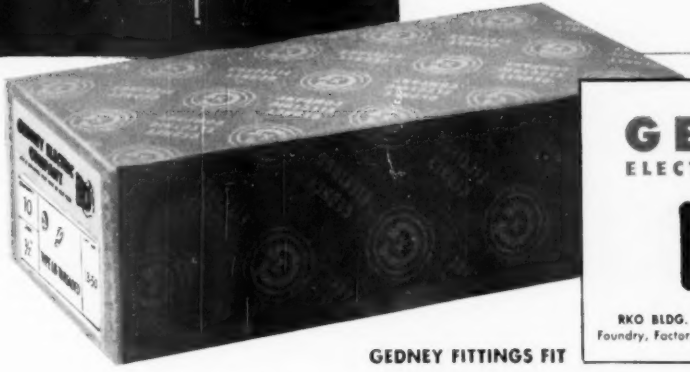


Corner Pull-In Elbows in ½", ¾" and 1" sizes. Ideal for space-saving, machine wiring, easy wire pulling. Cadmium plated.



3-Piece Conduit Couplings in a large range of sizes from ½" to 6". Cadmium plated.

One-Hole Pipe Straps, Clamp Backs, and the handy new Gedney Nest Backs. These supplementary spacers nest firmly behind the Clamp Backs — use as many as you need to hold pipe at desired distance from wall. Hot dip galvanized to prevent corrosion.



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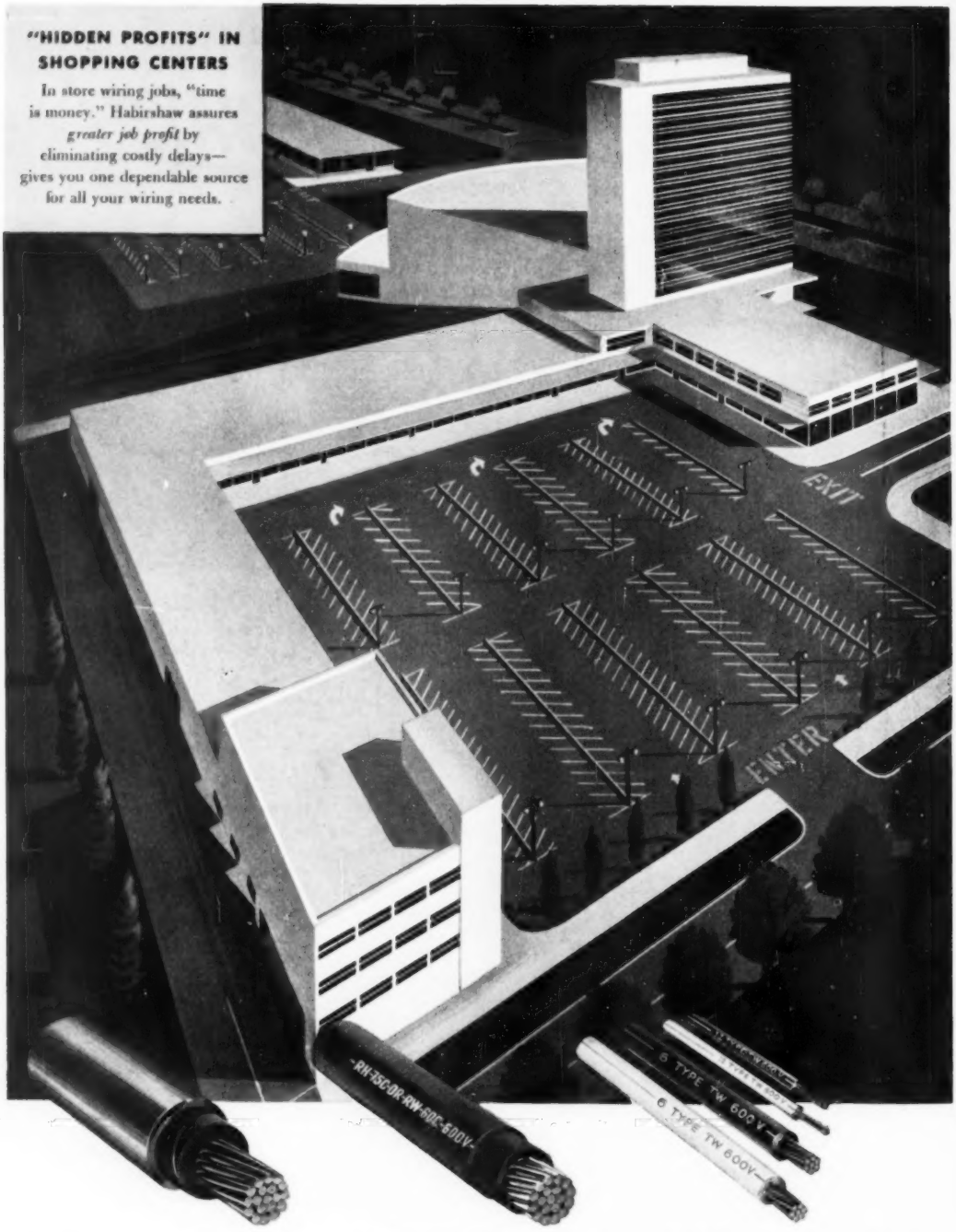
Foundry, Factory and Shipping Point: Terryville, Conn.

"HIDDEN PROFITS" IN SHOPPING CENTERS

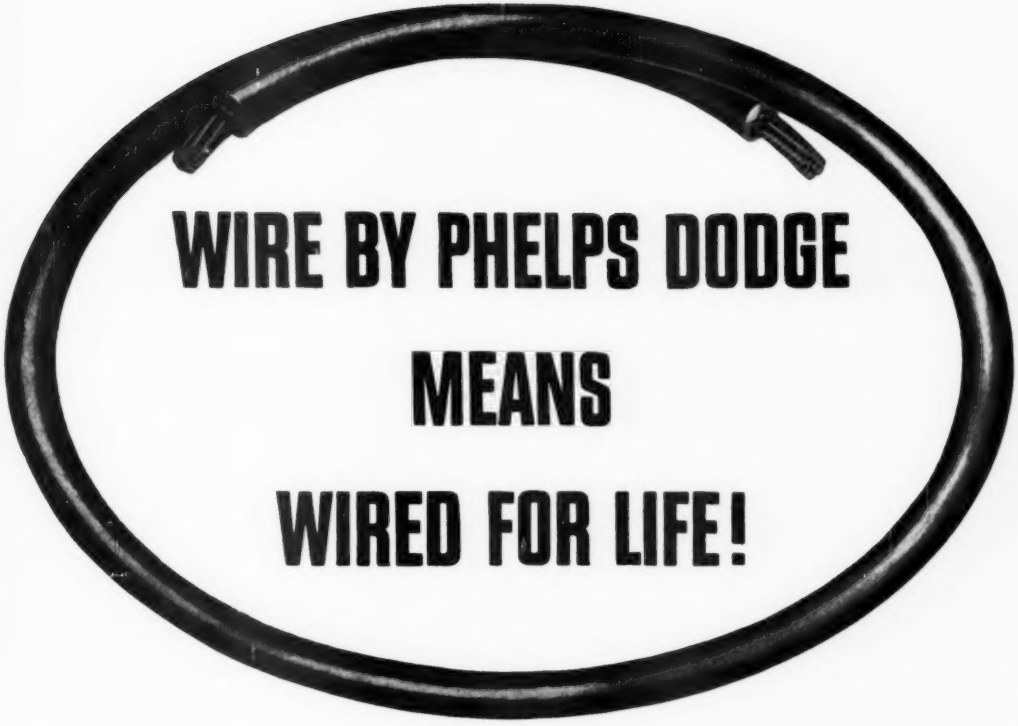
In store wiring jobs, "time is money." Habirshaw assures *greater job profit* by eliminating costly delays—gives you one dependable source for all your wiring needs.



• Primary—varnished cambric insulated lead sheathed cable for bringing power into the building.

• Heat-resistant, moisture-resistant, rubber-insulated, braid-covered cable for feeders to distribution points.

• Small-diameter, moisture-resistant Habirdure thermoplastic insulated wire for branch circuits.



WIRE BY PHELPS DODGE MEANS WIRED FOR LIFE!

Depend on Quality Wire to Build Your Own Reputation for Quality Work!

You can count on *Habirshaw* building wire—a product of the Phelps Dodge Copper Products Corporation—for highest standards of technical excellence. Habirshaw quality is controlled *directly* by exhaustive tests through every step of manufacture to assure precision workmanship and product reliability.

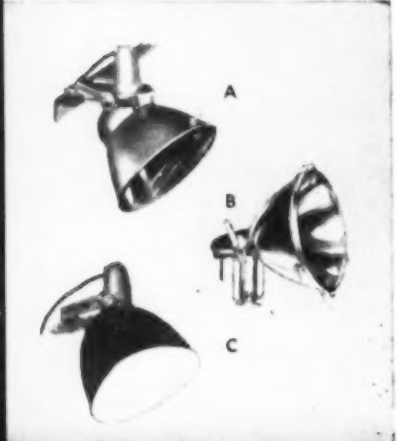
See Your Phelps Dodge Distributor!

PHELPS DODGE COPPER PRODUCTS CORPORATION

"DEAD STORAGE" AREA AT NIGHT . . . TRANSFORMED INTO USEFUL WORK AREA BY G-E OUTDOOR INDUSTRIAL LIGHTING

Get more business, bigger profits installing G-E Outdoor Lighting

A LIGHT FOR EVERY NEED is available from G.E.'s full line, for example: **A** High efficiency, lightweight, easy-to-install area floodlight for crossarm mounting, with three beam spreads; **B** Heavy-duty, wide variety of mountings and beam spreads; **C** Inexpensive, open floodlight for closer-range illumination.



By using easy-to-install, competitively priced *General Electric* outdoor industrial lighting equipment, you can do a *quality* lighting job which will pay off in more business and higher profits.

DOUBLES VALUE OF WORK AREA. Capitalize on the many big benefits your customer gets from a good lighting installation. In the picture above, for example, a large outdoor area is actually *doubled* in value because it is made completely useful at night as well as day. Other major benefits are the prevention of costly accidents, pilferage and sabotage. Consider the importance of these benefits today. Specify G-E lighting equipment to assure your customer of maximum performance with minimum care.

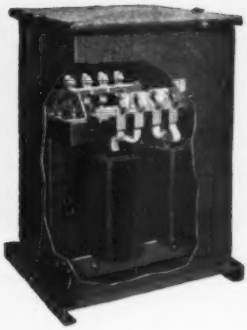
PROMPT SHIPMENT. You can get G-E outdoor industrial lighting equipment right out of stock at shipping points throughout the country.

FAST, EASY INSTALLATION. You'll find that G-E lighting equipment is designed for speedy mounting anywhere. And you can get all the help you need from G.E.'s staff of lighting specialists to do the job right—and fast. For more information write today for new Bulletin GEA-3640D. *Address Section 451-178, General Electric Company, Schenectady 5, New York.*

CAPITALIZE ON G-E OUTDOOR INDUSTRIAL LIGHTING

GENERAL ELECTRIC

ALLIS-CHALMERS
Dry-Type
TRANSFORMERS



He's Boosting Low Voltages!

How? By installing an Allis-Chalmers dry-type transformer close to the load it serves. This will result in higher motor, lighting and thermal efficiency and safe, economical utilization of power for plant equipment.

Mounted on overhead trusses, these dry-type transformers free valuable floor space for production purposes. They can also be mounted on walls or columns. Vaults or expensive enclosures are not required.

Speed Installation

Allis-Chalmers dry-type transformers are easy to connect because junction boxes are eliminated. For connecting the conduits directly to the transformer case, knockouts are provided. System cables are connected to the transformer terminals in roomy compartments.

Easy to Maintain

Install them and forget them except for periodic inspections. No insulating liquids to mess with; no gauges or gaskets to fuss with.

You can get more information about these Allis-Chalmers Class B insulated dry-type transformers from your Allis-Chalmers district office. Or write Allis-Chalmers, Milwaukee 1, Wisconsin. A 3829

They're Endurance Built

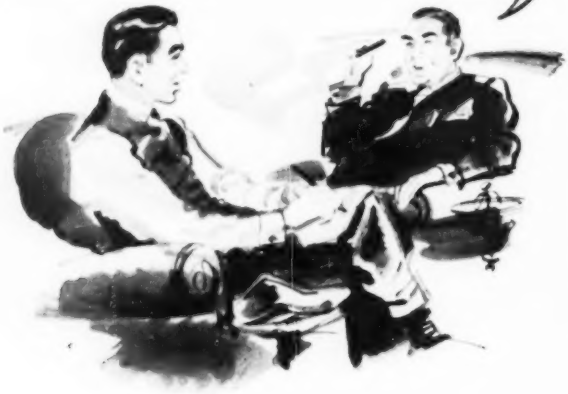
Core and coil assembly is impregnated to guard against moisture and dirt. All-welded, modern-looking case protects the internal assembly. Case is *Spra-Bonderized* to protect it against corrosion. Three coats of baked-on alkyd resinous paint furnish additional protection.

Ratings 167 kva and smaller (single phase); 300 kva and smaller (three phase), 600 volts and below.

ALLIS-CHALMERS

"I'm sold on Edwards and their way of doing business"

"Their equipment's tops, too. You don't need a trapeze artist to install it!"



Fact! Today more and more contractors and distributors prefer Edwards. And for excellent reasons. They like:

Edwards *Dependability:* For over 80 years Edwards has pioneered in the design and development of precision-built Electrical Signaling, Communication and Protection equipment for Schools, Hospitals, Industry, Offices and Homes.

Edwards *Cooperation:* All Edwards equipment is designed with the contractor in mind . . . to install easily, economically . . . save him maintenance, man-hours, overhead . . . deliver a bigger profit on every job.

Edwards *Protection:* All Edwards business goes through the distributor who services the contractor in the sale of Edwards staples. The distributor also profits from the system business developed by Edwards. *Double* reward!

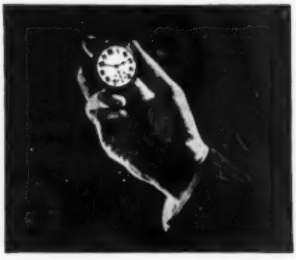
Edwards *National Advertising:* Month after month Edwards advertising in leading national magazines reaches important prospects in major markets . . . builds business and profits for distributors and contractors not only for systems but Edwards staples as well.

It pays to work with Edwards.

EDWARDS®

World's Most Reliable Time, Communication and Protection Products For Schools, Hospitals, Industry and Homes.

Time is Money to Contractors

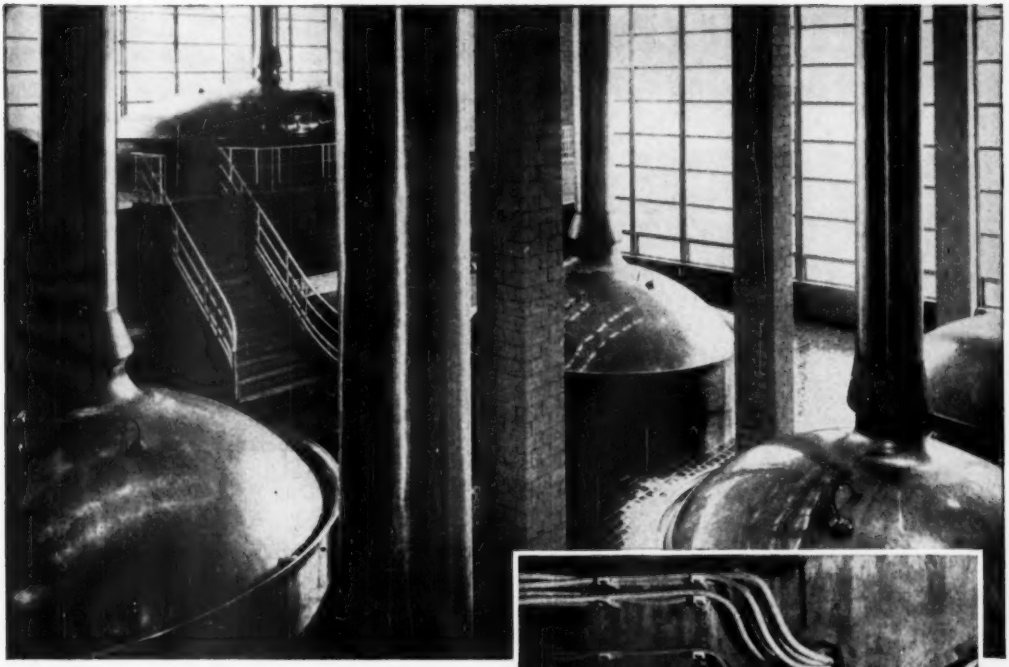


Edwards equipment is designed to save the contractor valuable man hours . . . give him a bigger profit on every job. Here are a few examples:

- **The new Edwards Fire Alarm Station can be mounted without balancing or juggling . . . wires connect to terminals from the front.**
- **The mounting plates of the Adaptabel and Adaptahorn can be fastened to any standard backbox.**
- **Edwards Easi-Mount Transformer can be installed through knockouts in standard backboxes by tightening the screw on the outside of the box.**
- **Program Instrument Backboxes can be mounted before plastering.**
- **Edwards Audio-Visual Hospital Equipment fits standard gang face plates and backboxes. Telephone jacks, outlet receptacles also can be mounted and ganged together.**

These are a few of the many Edwards advantages that spell maximum ease of installation, rugged, trouble-free operation with minimum servicing and maintenance. Time means money to contractors. Save it with Edwards.

For further information, write Dept. E-12, Edwards Company, Inc., Norwalk, Conn.



they use the best of everything
at

Anheuser-Busch

Famous the world over for its fine quality, Budweiser Beer is carefully and expertly brewed from the very choicest ingredients. Of equal importance are the equipment and techniques used; and so, throughout the entire brewing cycle, Anheuser-Busch leaves nothing to chance.

In keeping with this policy, Anheuser-Busch's new brewery at Newark, N. J., uses Okolite-Okoprene cable throughout for primary and distribution feeders. Since an uninterrupted power supply is an important factor in maintaining the famed Budweiser quality, only the best electrical cables will do — Okolite-Okoprene cables.

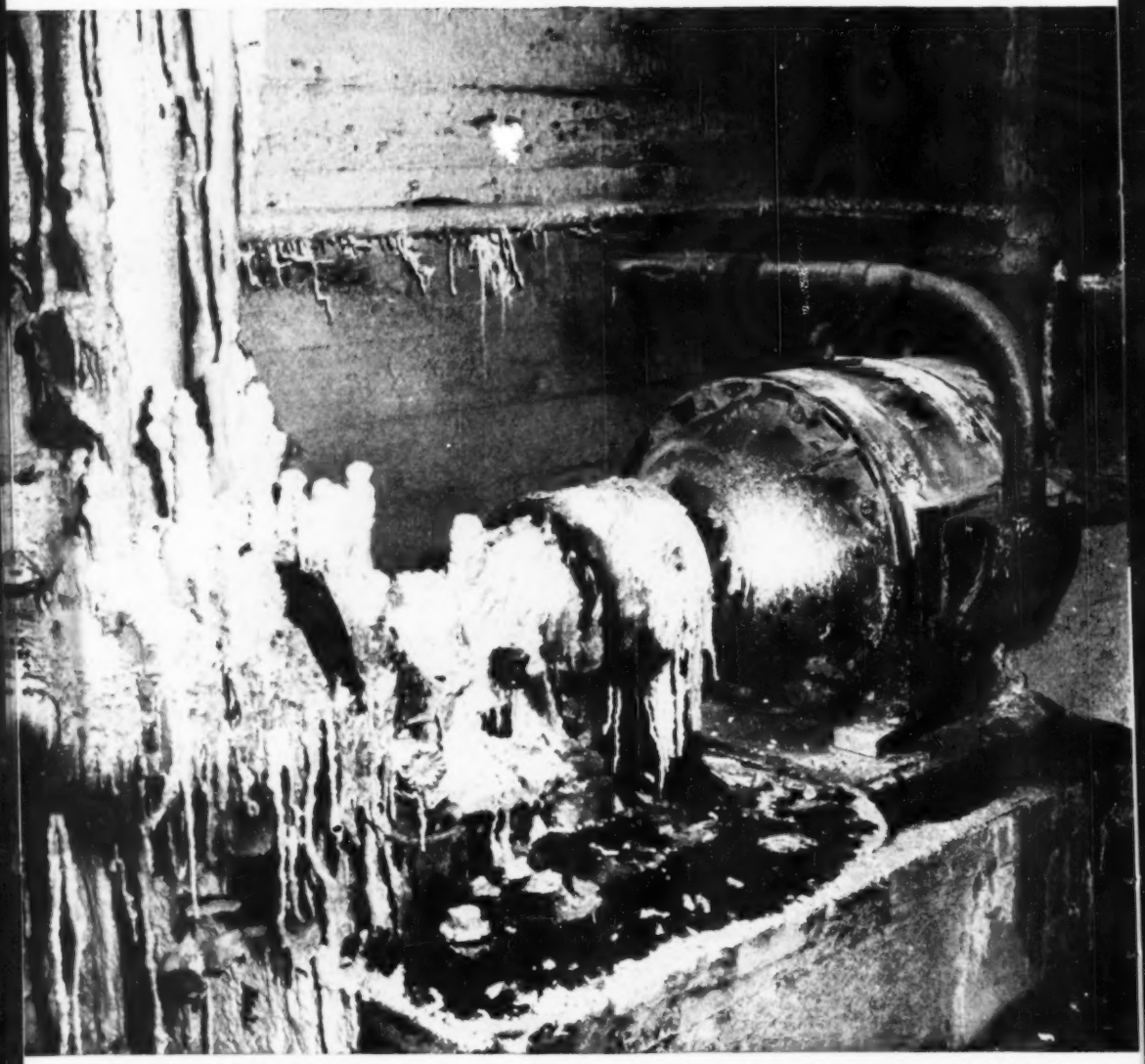
It's the doubly durable combination of Okolite insulation and Okoprene sheath which makes these cables the No. 1 choice for electrical circuits which must not fail. The Okolite insulation provides maximum dielectric strength; the Okoprene sheath is impervious to moisture, heat, sunlight, weather, and most oils, acids and alkalies. Together, insulation and sheath applied by Okonite's strip process provide the circuit security which cannot be obtained by conventional methods of cable manufacture.

The research and engineering which go into all Okonite cables, the extremely high test voltages, the unusual and exclusive manufacturing techniques, will interest every engineer. You'll find it all in Bulletin EC-1053. The Okonite Company, Passaic, N. J.

The best cable is your best policy

OKONITE *insulated wires and cables*

WHEN JOBS ARE TOUGH



CORROSIVE ATMOSPHERE doesn't bother this standard, "off-the-shelf" Tri-Clad motor. Totally enclosed, fan cooled, it runs 12 hours a day, six days a week, driving a flash cooler pump under tough conditions in a chemical plant.

GENERAL ELECTRIC

INDUSTRY DEPENDS ON G-E TRI CLAD MOTORS

REG. U.S. PAT. OFF.

Here are three typical tough jobs being done safely, economically, and without interruption, by G-E Tri-Clad motors. They help show why more than 10,000,000 horsepower of G-E Tri-Clad motors are serving American industry today.

WIDEST VARIETY

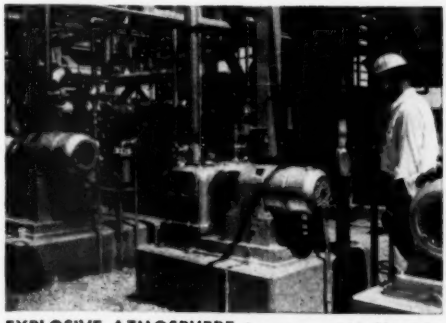
With the widest selection of standard motors obtainable anywhere, the Tri-Clad motor line offers ratings up to 2000 hp; all types of enclosures; gear motors, brake motors, and adjustable-speed drives—plus many other mechanical and electrical modifications to meet your requirements.

TRIPLE PROTECTION

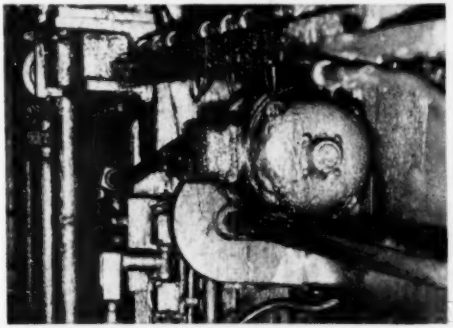
You get triple protection with *every* Tri-Clad motor—against physical damage, electrical breakdown, and operating wear and tear. Completely enclosed bearings last longer because they can be relubricated if necessary—and *without shutdown!* For specific product information, use the coupon below, or contact your nearby G-E Apparatus Sales Office, authorized G-E Agent or Distributor.

IMMEDIATE DELIVERY

Most standard G-E Tri-Clad motors are available immediately from stock. And the most complete sales and service network in the motor industry assures you prompt service by trained specialist and application engineers, for all your motor problems. General Electric Co., Schenectady 5, New York. 752-16



EXPLOSIVE ATMOSPHERE dangers are avoided by using standard explosion-proof Tri-Clad motors, such as these gear-motors driving water and hydrocarbon pumps in an oil refinery.



OIL, MOISTURE, ABRASIVE DUST can't stop this totally-enclosed Tri-Clad motor, operating below the strip in a cold strip steel mill. Motor is completely protected inside and out.

PROGRESSIVE MECHANIZATION . . .

a new G-E MORE POWER TO AMERICA program—motion picture and manual—case histories of the latest mechanization trends.

Send for literature.

Section J 752-16
General Electric Co., Schenectady 5, N. Y.

Please send me the following on Progressive Mechanization:

☐ **Free copy of the Progressive Mechanization Manual (GEA-5789)**

Please send the following product bulletins:

☐ **GEA-3580 (Open Dripproof Motors)**

☐ **GEA-4400 (Totally Enclosed Motors)**

Name .....

Firm .....

Address .....

City ..... **Zone** ..... **State** .....

Prest-O-Lite
Trade-Mark

dissolved ACETYLENE

in small tanks for SOLDERING, HEATING, LIGHT BRAZING

because...

PREST-O-LITE Gas Tanks are built to quality standards even beyond government specifications. This means extra resistance to dents, punctures, and corrosion—an extra measure of ruggedness that pays off in added years of economical service.

because...

PREST-O-LITE Tanks are checked and serviced *every time we charge them*, under a rigid plant routine that surpasses both Federal and State fire and safety requirements.

because...

This *complete* small tank service assures you of maximum protection and convenience. It is available exclusively through authorized distributors who handle only genuine PREST-O-LITE Gas and Small Tanks.

because...

PREST-O-LITE Gas is so easy to get. Thousands of authorized PREST-O-LITE Gas Service Stations throughout the country can supply new tanks or exchange full tanks for your empties. Write for addresses of those near you. LINDE AIR PRODUCTS COMPANY, a Division of Union Carbide and Carbon Corporation, 30 East 42nd St., New York 17, N. Y.

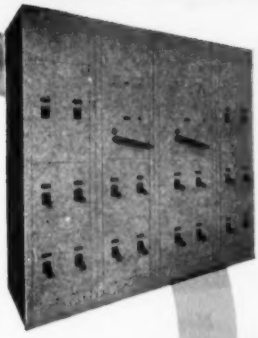
PREST-O-LITE Gas is available in two convenient sizes of steel tanks: MC Tank (left) holds 10 cubic feet; B Tank (right) holds 40 cubic feet.

The term "Prest-O-Lite" is a registered trade-mark of Union Carbide and Carbon Corporation.

for maximum Service . . .

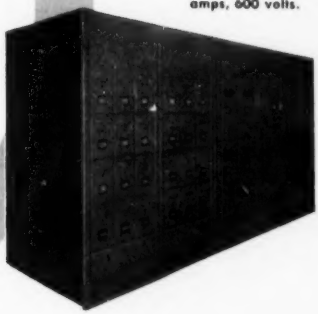
INSTALL FA

FA SHUTLBRAK
30 to 1200 amps, 250 volts AC or DC and 600 volts AC.



FA CIRCUIT BREAKER
15 to 600 amps, 250 volts AC or DC and 600 volts AC. For larger capacities, Air Circuit Breakers are used.

FA KLAMPSWITCHFUZ
30 to 600 amps, 250 volts AC or DC. SNUFARC, 30 to 200 amps, 600 volts.



STANDARDIZED SWITCHBOARDS

STANDARDIZED FA SWITCHBOARDS are noted for their efficiency, safety, and dependability.

Built of standardized pre-assembled units, incorporated in standardized enclosures, these sturdy, long-lasting and trouble-free power centers embody the latest features of design and operation.

Standardized FA Switchboards are of three types — the **Shutlbrak**, a safety type switchboard designed for frequent operating use; the **Klampswitchfuz and Snufarc**, which features a dependable hinged type, pull-out switch unit for disconnect service on lighting and power circuits, and the **Circuit Breaker**, another safety type, featuring the latest developments in automatic circuit protection.

All Standardized FA Switchboards are factory assembled and shipped ready for connection to main and branch circuit cables. Units can be arranged singly or grouped because all sections fit readily together. Removable end walls permit the addition of sections on either side.

Want to know more about these efficient, long-lasting power centers? Your nearest FA representative listed in Sweet's will be glad to give you complete information.

Frank Adam Electric Co.

P. O. BOX 357 ST. LOUIS 3, MISSOURI

Our 61st Year

Makers of BUSDUCT • PANELBOARDS • SWITCHBOARDS • SERVICE EQUIPMENT • SAFETY SWITCHES • LOAD CENTERS • QUIKHETER

110-550 Volt
MOTOR
STARTERS

Manual Magnetic Combination

ACROSS-THE-LINE STARTERS are easy to install and wire—compact enough to be installed on or near the controlled machine. Manual Starters in sizes 0 and 1, Magnetic in sizes 0-7 for motors from fractional to 600 hp. Combination in sizes 0-5. General Purpose and special enclosures to fit every need.

Manual Magnetic

REDUCED-VOLTAGE STARTERS are used where the power system has insufficient capacity for full-voltage starting . . . to safeguard machinery or processes from high starting torque or current intush. Choose from autotransformer, reactor and resistor types. Wide line available.

STARTERS for

Choose From This Wide Selection of Generously Designed Starters . . . Backed by Broad Application Experience in Every Industry

WHATEVER YOUR CONTROL NEED — starting, smooth acceleration, speed control, stopping, reversing, dynamic braking — there is an Allis-Chalmers starter to do the job. All are easy to install and have construction features that assure long life, dependable operation, simplified inspection.

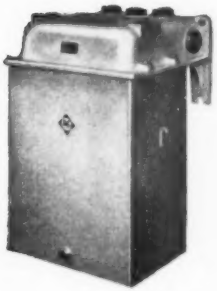
Low-Voltage Starters, Sizes 0-3 for example, have silver-to-silver double break contacts that never require dressing. A screwdriver is the only tool you need for inspection of magnet coils, heaters, contacts — all replaceable parts.

Sizes 4-7 have time-proven clapper-type contacts with rolling-wiping action to keep current carrying areas clean, free of pitting and arcing. Current is interrupted quickly and arcing minimized by chutes of new design. All electrical and mechanical parts are easily accessible.

High-Voltage Starters give you everything needed for complete motor control and protection in a single enclosure. Contactors, meters, overload relays, auxiliary switches — all needed parts are selected to meet the requirements of your application. Enclosures are compartmented to isolate high-voltage devices. If you need the short circuit protection of current limiting fuses, specify Type H high-voltage starters.

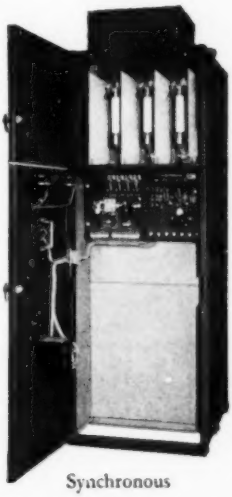
Remember, A-C application engineers have wide experience serving all industry. Their experience, plus this broad line of starters, is your assurance of the right starter for your job. Call your nearby A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

2300-5000 Volt MOTOR STARTERS



Squirrel-Cage

THE TYPE 371 Wall-Mounted Starter for 2300-volt motors is completely sealed . . . protects the completely oil-immersed mechanism from weather, corrosion and dust. Wall mounting saves space.



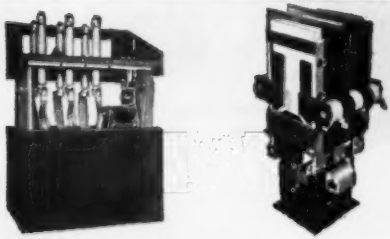
Synchronous

ALLIS-CHALMERS Synchronous Motor Starters apply field excitation automatically when proper speed is reached . . . even select the exact half cycle for smoothest field application.

Wound-Rotor

WOUND-ROTOR Motor Control for either starting or speed control duty, is built with the number of accelerating points your application requires. High-Voltage Starters are built for motors to 2500 hp.

Every Motor Need!



OIL-IMMERSED or AIR-BREAK — The contactor best suited to your application is standard in Allis-Chalmers high-voltage starters. Both are designed for ready access — built to give long life, low maintenance. Air-break contactors available with interrupting capacity to 50,000 kva.

Allis-Chalmers, Milwaukee 1, Wisconsin

Send for These

Send me the bulletins indicated below:

- ☐ High-Voltage Starters - - - - - - 1486410
- ☐ Type 371 Wall-Mounted Starter - - - 1487274
- ☐ Type 256 Air Contactor - - - - - 1487303
- ☐ Low-Voltage Across-the-Line Starters - - 1487132
- ☐ Low-Voltage Reduced-Voltage Starter - - 1487215
- ☐ Control Devices - - - - - - - - 2587095

Name.....

Title..... Company.....

Address.....

City..... State..... A-3539

ALLIS-CHALMERS

General Purpose . . . one, two or three pole

Dust Tight . . . one, two or three pole

Explosion-proof (Class I, Group D) . . . one, two or three pole

GROWING in usage all the time . . .

. . . BECAUSE THESE CIRCUIT BREAKERS ARE *HYDRAULIC-MAGNETIC*

ONE FACT . . . that HEINEMANN Circuit Breakers are unaffected by ambient temperature . . . is the greatest reason for the growing demand. Time delay for starting inrush and momentary overloads is provided by a hydraulic-magnetic operating principle . . . eliminating thermal elements, thus also eliminating the need for de-rating to compensate for temperature change. HEINEMANN Circuit Breakers are unaffected by the summer heat or winter cold . . . by adjacent heating pipes or open windows.

No need for de-rating also, in effect, increases your power capacity because you can always carry the full safe rated load of the wires.

All these enclosure types are available for the growing business in the HEINEMANN Circuit Breaker line.

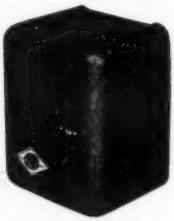
Send for literature. HEINEMANN ELECTRIC CO., 132 Plum Street, Trenton 2, New Jersey.

don't use heat . . . *USE POWER*

HEINEMANN Circuit Breakers

HEINEMANN Circuit Breakers. One, two and three pole. 10 milliamps to 100 amperes.

Explosion-proof (Class I, Group D) . . . one, two or three pole



Safelet . . . also available with pilot light and receptacle

Indoor Service Center

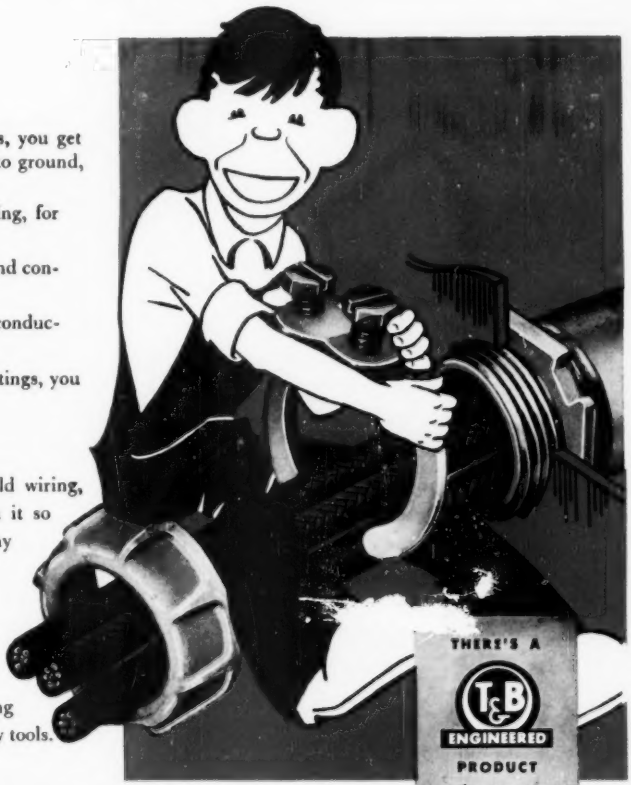
Auxiliary Explosion-proof Housing . . . one or two circuit breakers

Outdoor Service Equipment . . . up to 100 amperes

Temporary Service Unit

Make APPROVED box-to-conduit grounds this LOW-COST way

Just slip a T & B Grounding Wedge over the wires—and clamp it in place quickly . . . easily . . . lastingly



HERE'S WHAT YOU GET

With these T & B Grounding Wedges, you get *triple* assurance of continuity bonding to ground, because . . .

1. Bonding screw bites firmly into bushing, for a tight wedge and a lasting bond
2. Flange fits snugly between box wall and conduit threads
3. Springy bronze body maintains high-conductivity path to ground.

And with these universally approved fittings, you get quick inspection OK's.

HERE'S HOW YOU SAVE

You can slip the wedge right over old wiring, without disturbing it at all. You turn it so screws are easy to tighten. You do away with inside lock-nuts—and most of the time, with bonding jumpers too. (If you do need a jumper, just connect it to the bonding screw.) You convert standard bushings, of all conduit sizes, to approved grounding bushings in a few seconds, with ordinary tools.

THERE'S A T&B ENGINEERED PRODUCT for every wiring job in the complete T & B line of fittings for all conductors and raceways.

UL

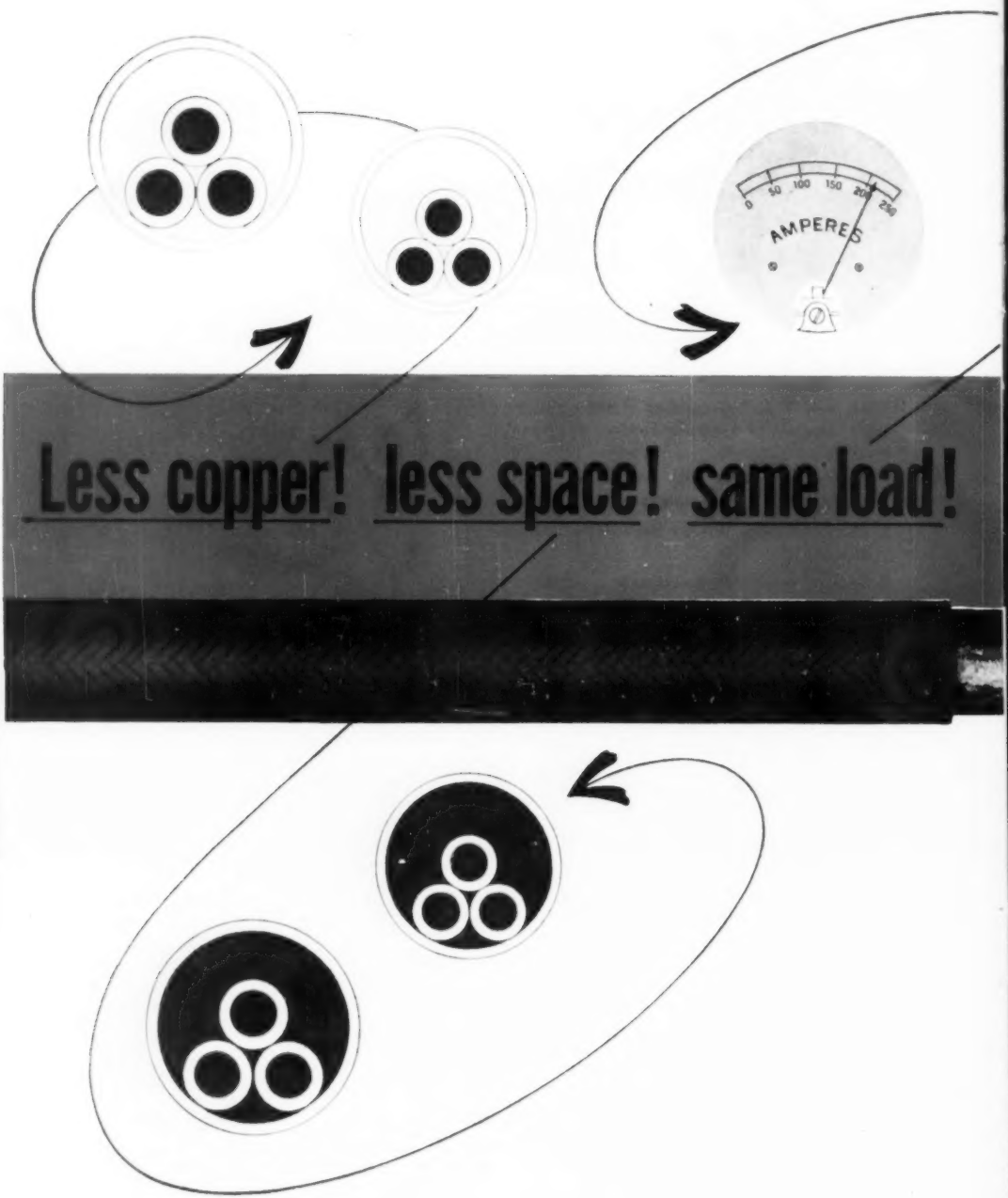
ENGINEERED RIGHT . . . DISTRIBUTED RIGHT! Grounding Wedges are typical of the many T & B quality fittings recently re-designed to give you outstanding performance at lowest installed costs. Like all T & B fittings, they're furnished under the T & B Plan 100% through your local T & B distributor. For further information or samples, see your local T & B distributor, or write us.

THE THOMAS & BETTS CO.

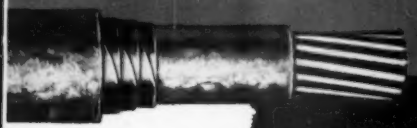
INCORPORATED

34 Butler Street
Elizabeth 1, New Jersey

MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1898


0
50
100
150
200
250
AMPERES
Less copper! less space! same load!

with NEasbestus



Faced with an overloaded, out-of-date wiring system? Then consider NEasbestus, National Electric's asbestos-varnished cambric wires and cables. With NEasbestus you buy *less* copper, require *less* conduit space, yet deliver the *same load!*

NEasbestus wire can permissibly operate at higher temperatures than the same size rubber or thermoplastic insulated conductors according to the National Electrical Code. Thus, you can use smaller sizes of NEasbestus wire to carry a given load. For example:

Size 500 MCM-RH—capacity 380 Amperes.

Size 350 MCM-NEasbestus—capacity 390 Amperes. (Approximately 20% savings in cross-sectional area)

Size 1000 MCM-RH—capacity 545 Amperes.

Size 700 MCM-NEasbestus—capacity 560 Amperes. (Approximately 27% savings in cross-sectional area)

With NEasbestus wire you can use your present conduit—save the cost of new, enlarged conduit runs and resultant structural alterations. Just pull out the old wires, pull in NEasbestus.

- Save the cost of new, larger-sized cable.
- Save major carpentry, plastering, painting repair bills.

For maximum continuous operations in external or *internal* hot spots, install NEasbestus today. There's a sales office near you.

Write today for the free NEasbestus catalog

EVERYTHING IN WIRING POINTS TO

National Electric Products

PITTSBURGH, PA.

3 PLANTS 7 WAREHOUSES 42 SALES OFFICES

SORGEL AIR-COOLED Dry-Type TRANSFORMERS

for Every Purpose

To operate 115 volt lighting and portable equipment from 230, 460 or 575 volt power circuits, and higher distribution voltages.

To operate special equipment from standard circuits.

To change odd voltages to standard voltages and phase changing.

Also Sub-Stations and Power Centers

for indoor installations

Engineered to meet your exact requirements. Not necessary to design or change your installation to fit a "standard."

Any type of primary switch gear.
Metering—primary or secondary, to suit.
Secondary breakers, main, branch, or tie.

All incorporated with high quality, liberally designed **SORGEL Air-Cooled Transformers.** All factory assembled, wired and tested. **Mounted on a substantial steel base.** Shipped as a single unit or in sections, accurately co-ordinated for **easy assembly on the job.**

Sizes up to 2000 Kv-a. All voltages up to 15 KV.

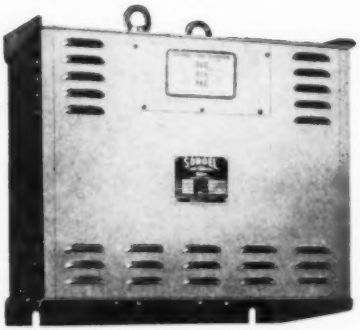
Complete Line . . . .

¼ to 2000 Kv-a.

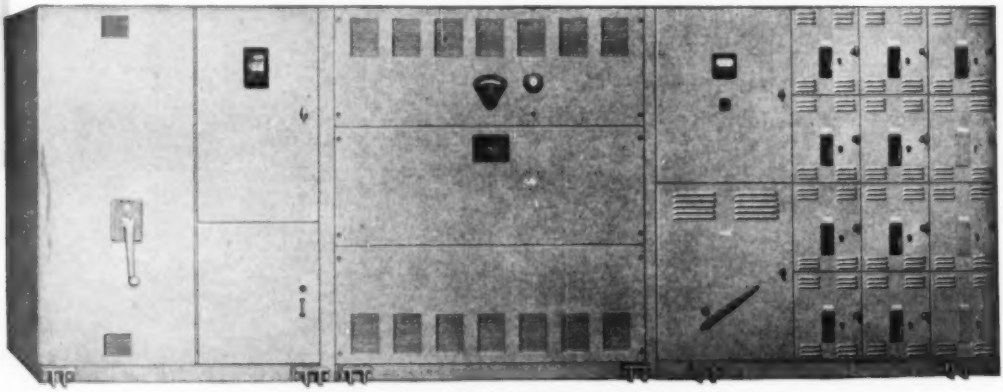
Single phase and poly-phase.

120, 240, 480, 600, 2400, 4160, 4800, 7200, 13,200, and 14,400 volts

¼ Kv-a. Single phase 460/230 to 230/115 volt



20 to 50 Kv-a., 3-phase. Wall Mounting Type.



2000 Kv-a., 3-phase, 13,200 volt unit Sub-Station
With forced draft fans, automatically controlled by temperature indicator to increase transformer capacity 25%; primary fused load break switch and kilwatt-hour meter, secondary voltmeter and drawout circuit breakers.

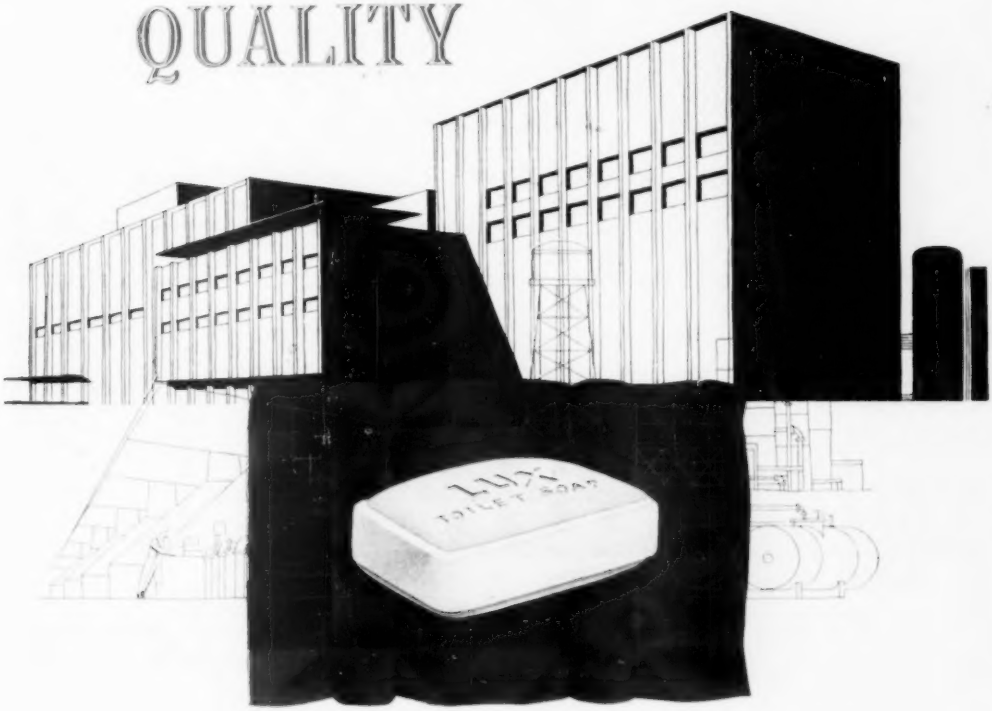
Sales Engineers in Principal Cities

SORGEL ELECTRIC CO., 836 West National Ave., Milwaukee 4, Wis.

Pioneers in the development and manufacturing of Air-Cooled Transformers

the Accent's on

QUALITY



...so Lever Brothers selected quality-controlled

SPANG CENTRAL CONDUIT

to protect electrical lifelines

In the most modern soap and shortening plant in the world—recently dedicated in Los Angeles County—the emphasis is on product quality, as in all Lever Brothers Company factories.

Every part, every machine, was selected with the greatest care to eliminate interruptions that might affect the exact, careful blending of raw materials. Electrical lifelines, for instance, are safeguarded by Spang "Cenlaco" Conduit—the conduit that's quality-controlled so it is always uniform in every way, always free from defects.

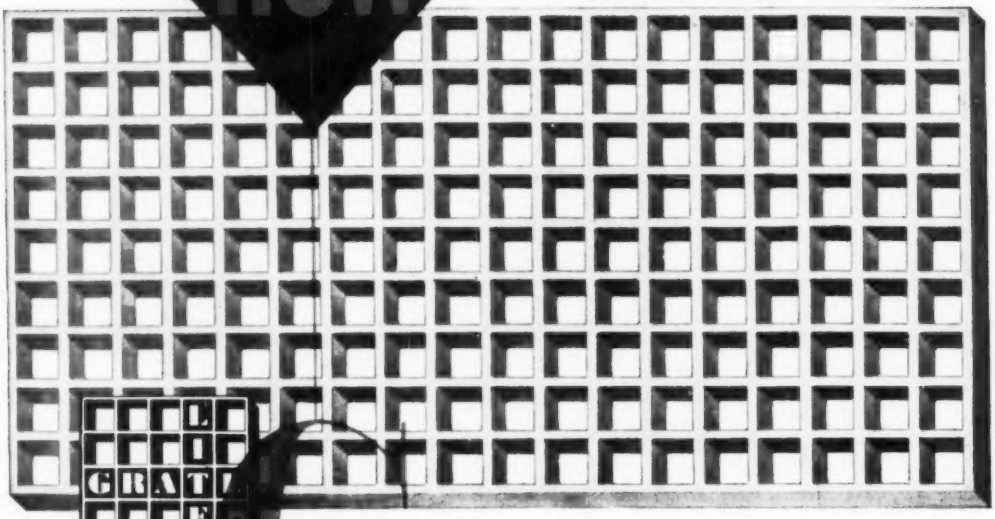
Wherever reliability is a must—easier, faster installation important—outstanding architects, contractors and owners specify conduit by Spang. Approved by the National Board of Fire Underwriters and complying with the National Electrical Code, it's *made better* for *better protection* of electrical circuits.

Owner:
Lever Brothers Company
Designers and Builders:
The Bechtel Corporation
Electrical Engineering:
The Bechtel Corporation
Consultant Architect:
Welton Becket and Associates

SPANG-CHALFANT
Division of The National Supply Company
GENERAL SALES OFFICE
GRANT BUILDING, PITTSBURGH 30, PA.
District Offices and Sales Representatives
in Principal Cities

new

OPEN LIKE A LATTICE
DIFFUSING LIKE GLASS



Guth GrateLite* Louvre

the latest idea in lighting

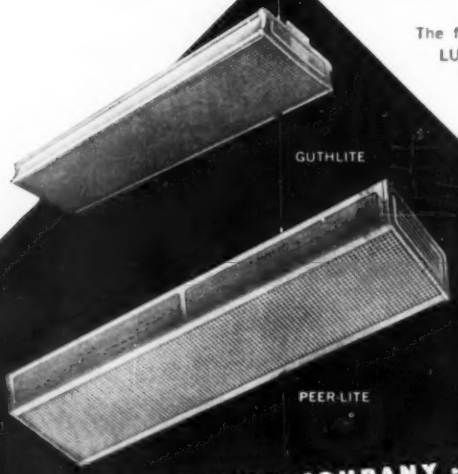
A SYMPHONY OF DIFFUSED LIGHT

* U.S. & Can. Pats. Pend.

The first integral plastic louvre for fluorescent lighting, molded of LUSTREX polystyrene. It reveals a new conception of architectural beauty and efficient lighting: Its diffusion results from the ⅜" cubical lattice that cuts off direct light at a 45° angle.

But words alone cannot describe beauty. See for yourself and ask to be shown a sample. It will give you a new outlook on lighting.

GrateLite is tough, quickly cleaned and de-staticized. It is furnished in one piece with Guth Fluorescent Fixtures.



GUTH'S GOLDEN YEAR 19 Guth 52 ...leaders in lighting since 1902

THE EDWIN F. GUTH COMPANY • ST. LOUIS 3, MO.

ACCURATE TAPES ...for every INSULATING need!

Your logical SOURCE
—for all tape requirements!

Good workmanship in wiring calls for good materials. Make certain of tape quality by using the tape that's made with 30 years experience behind it!

ACCURATE
Plastic Tape

Offers a bulk-reducing combination of thin caliper, good mechanical and dielectric strength. Recommended for use wherever plastic tape is practical.

ACCURATE RUBBER TAPE

Features high elasticity, excellent cohesion, high dielectric and super aging qualities. Available in Standard and A.S.T.M.-A.A.R. grades.

ACCURATE FRICTION TAPE

High grade rubber carefully compounded with finest cotton base provides maximum mechanical protection for every wrap. Made in Standard and A.S.T.M. grades.

...no finer tapes at any price!

For big wiring jobs or small, Accurate is the choice for positive tape protection. Both friction and rubber are strong, pliable, easy to apply. Accurate tapes make accurate wraps — pull tight and clean over irregular surfaces. When you order tape, mention Accurate by name. It's the one sure way to complete tape satisfaction. For a complete guide to tape selection and tape buying, ask for the new Accurate Data Folder. Accurate Mfg. Company, Garfield, New Jersey — address inquiries to Dept. AA.

amc

ALECTI

(ALUMINUM)

BARE and WEATHE

GENERAL CABLE'S 20 YEARS OF RESEARCH AND EXPERIENCE WITH ALUMINUM WIRE AND CABLE *means...*

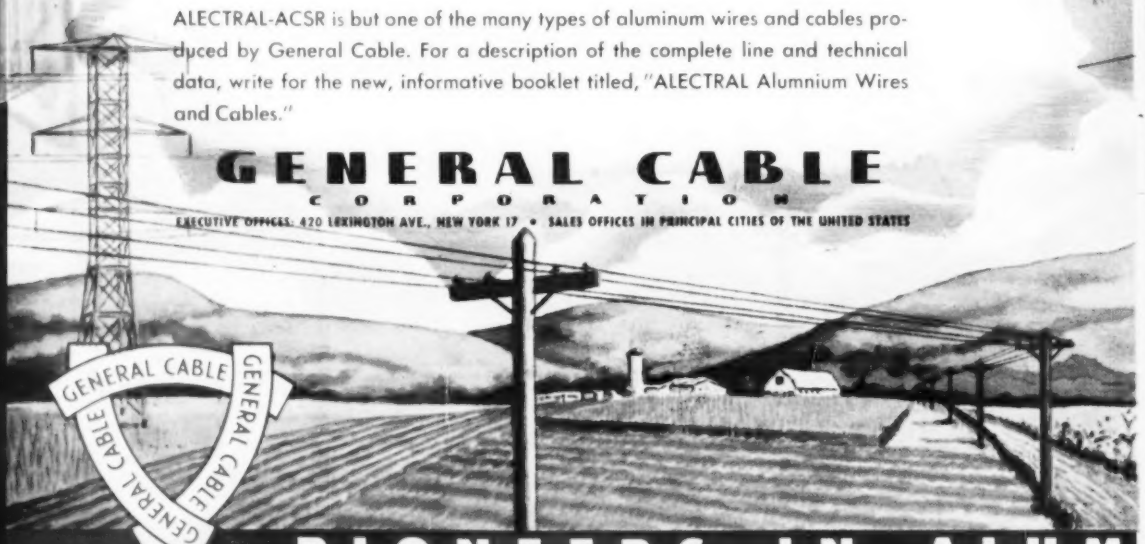
"More Power to You"

The General Cable line of ALECTRAL aluminum wires and cables has earned definite acceptance among engineers everywhere. Of special interest to the electrical industry is ALECTRAL-ACSR. As a bare conductor, it is most useful for transmission and rural distribution lines. With weatherproof covering, ALECTRAL-ACSR is also extremely advantageous for secondary circuits; particularly for spans where other conductors tend to sag excessively.

ALECTRAL-ACSR is but one of the many types of aluminum wires and cables produced by General Cable. For a description of the complete line and technical data, write for the new, informative booklet titled, "ALECTRAL Alumnium Wires and Cables."

GENERAL CABLE
CORPORATION

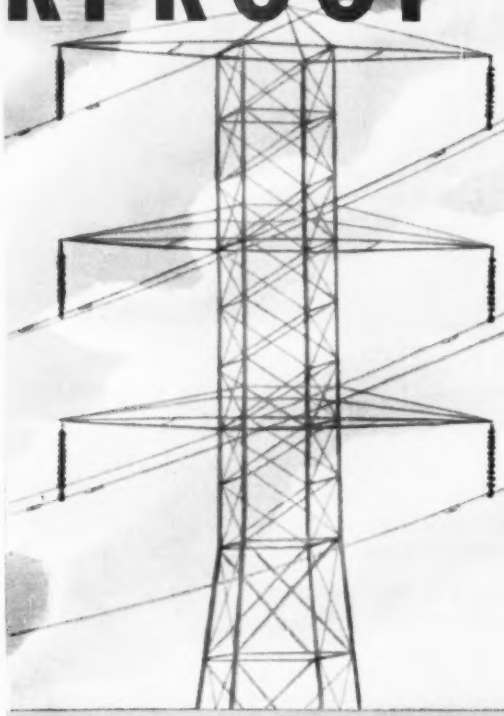
EXECUTIVE OFFICES: 420 LEXINGTON AVE., NEW YORK 17 • SALES OFFICES IN PRINCIPAL CITIES OF THE UNITED STATES



PIONEERS IN ALUM

RAL ACSR

RPROOF



ALECTRAL-ACSR

CONSTRUCTION

One, two or three layers of hard drawn aluminum wires of suitable size to give desired electrical characteristics are laid over a core of extra high strength, galvanized steel wire or strand.

WEATHERPROOF COVERINGS

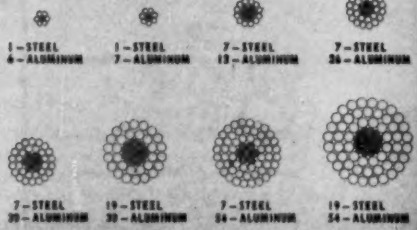
POLYETHYLENE—Of a low specific gravity, pigmented, light and heat stabilized polyethylene compound having high dielectric properties and excellent resistance to moisture and weather.

"O.K."—URC & "PEERLESS" URC—Asphalt-saturated, fibrous coverings in both double and triple-braid weights or Peerless construction.

"TIP-TOP" (Neoprene)—Tough, durable, weather-resistant, vulcanized neoprene compound. Minimum tensile sheath strength of 1600 psi.

"ALECTRAL", "O.K.", "PEERLESS", AND "TIP-TOP" ARE REGISTERED TRADEMARKS OF GENERAL CABLE CORP.

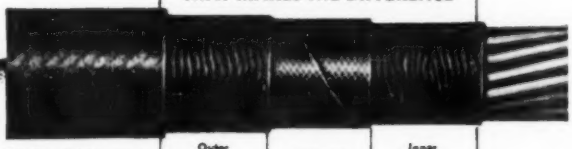
TYPICAL STRANDINGS



INUM WIRE AND CABLE

ROCKBESTOS A.V.C.® INSULATION ENABLES COPPER TO DO 60% MORE WORK THAN ORDINARY INSULATIONS

IT'S THE A.V.C. "SANDWICH" THAT MAKES THE DIFFERENCE



This "sandwich" protects the varnished cambric. It enables A.V.C. to carry more current than cables with conventional insulations.

Outer Felted Asbestos Wall	Varnished Cambric	Inner Felted Asbestos Wall

Chapter 10, Table 1 of the National Electric Code provides definite proof that high-rated Rockbestos A.V.C. carries more current . . . enables you to save critical copper and steel.

TABLE OF CURRENT CARRYING CAPACITIES
(Ambient Temperature 40°C — 104°F)

C M	TYPE AVA	TYPE RH
300000	**324**	251
350000	367	273
400000	395	295
500000	442	**334**

...Your best buy

ROCKBESTOS PRODUCTS CORPORATION
NEW HAVEN 4, CONN. *the originators of* **A.V.C.®**
New York • Cleveland • Detroit • Chicago • Pittsburgh • St. Louis
New Orleans • Los Angeles • Seattle • Oakland, California

LO-X Duct's scarf-lap joint slashes installation costs

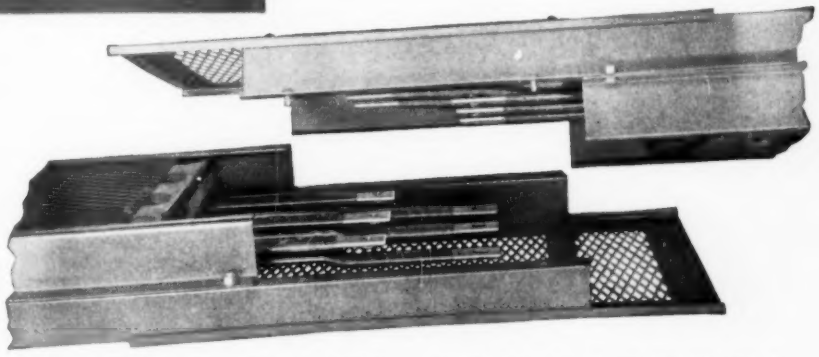
Contracting new bus duct jobs? Then check carefully into installation costs. For it is here, *with BullDog LO-X BUStribution Duct*, that you can save time, effort, materials, money.

Here's why: BullDog's *exclusive, patented* scarf-lap joint, described below, greatly simplifies installation. Makes LO-X Duct faster, easier to install; provides a stronger, more rigid system that cuts down time-wasting service calls. You and your customers save *substantially* on installation.

When considered along with other famous BullDog features, such as low voltage drop and low operating temperature, this reduction means BullDog LO-X Duct is a more salable system that brings *rock-bottom* current-carrying costs per ampere per foot.

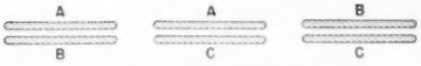
Why not contact your nearby BullDog Distributor for all the facts? LO-X Duct is used for feeder and welder circuits, carries up to 4000 amperes at 600 volts or less. Ask, too, about BullDog Plug-in Duct for branch circuits. Free literature available by writing direct.

HOW IT WORKS:



SCARF-LAP JOINT—One half of each LO-X casing extends 14" beyond other half; overlaps adjoining casing end to form a highly rigid scarf-lap joint. Casings lap together simply, quickly . . . save countless installation hours. No splice plates, bulky joint covers, or complicated construction to slow down the job and increase costs. No poor bus bar connections, either.

Bus bars overlap also, are bolted with splined steel inserts and special spring cup washers. Joint stays tight, whatever the current or temperature variations.



End view showing staggered-phase arrangement of bus bars in LO-X Duct.

PAIRED PHASING—Another LO-X *plus!* Bus bars are closely spaced inside ventilated casing and arranged in paired phases that neutralize magnetic fields, assure uniform current distribution all along bus bar. Current flows more evenly, voltage drop and temperature rise are reduced.

BULLDOG

BULLDOG ELECTRIC PRODUCTS COMPANY
DETROIT 32, MICHIGAN • FIELD OFFICES IN ALL PRINCIPAL CITIES
IN CANADA: BULLDOG ELECTRIC PRODUCTS OF CANADA, LTD., TORONTO
PIONEERS IN FLEXIBLE ELECTRICAL DISTRIBUTION SYSTEMS

1902 TO 1952 . . . SERVING INDUSTRY FOR 50 YEARS WITH FINER ELECTRICAL PRODUCTS

B-M *Fittings*

ARE APPROVED AS CONCRETETIGHT

When setting E. M. T. in concrete you can make each job easier and more profitable by using Briegel All Steel Indenter Fittings that have UL approval as CONCRETE-TIGHT. Contractors the world over recognize their cost cutting qualities and the fact that they make each wiring job a better job. It is only natural that Briegel Fittings are the most widely used E. M. T. connectors and couplings.

Cross Section Showing Indentations

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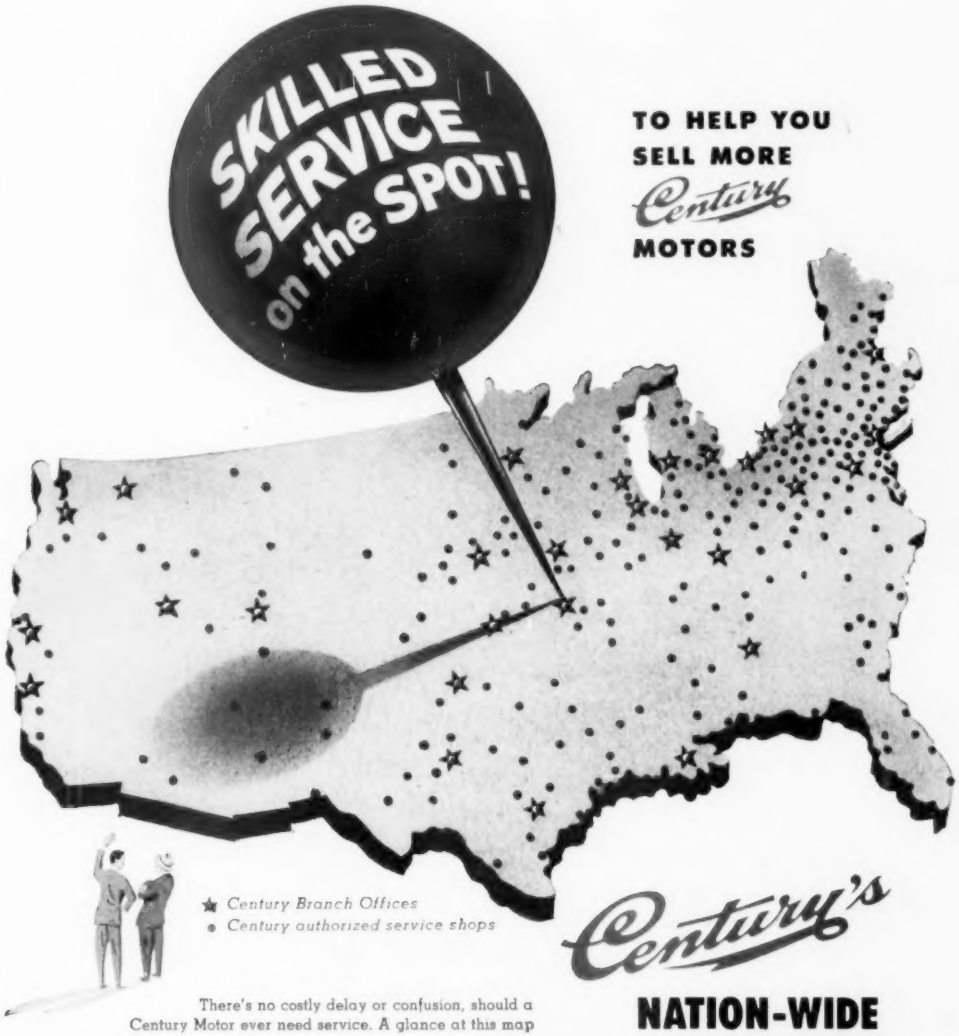
GALVA, • ILLINOIS

Distributed by

The M. B. Austin Co., Northbrook, Ill.; Clayton Mark & Co., Evanston, Ill.; Clifton Conduit Co., Jersey City, N. J.; General Electric Co., Bridgeport, Conn.; The Steelduct Co., Youngstown, Ohio; Pittsburg Standard Conduit Co., Pittsburgh, Penn.; Wagner Malleable Products Co., Decatur, Ill.; J. R. Richards Co., Carnegie, Penn.; Kondu Mfg. Co., Ltd., Preston, Ont.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TO HELP YOU SELL MORE Century MOTORS
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There's no costly delay or confusion, should a Century Motor ever need service. A glance at this map will show you why.

Hundreds of trained electric motor repair men in established independent service organizations are located convenient to motor users throughout the United States. They are equipped to give Century Motors the same kind of skilled care that is used in their manufacture.

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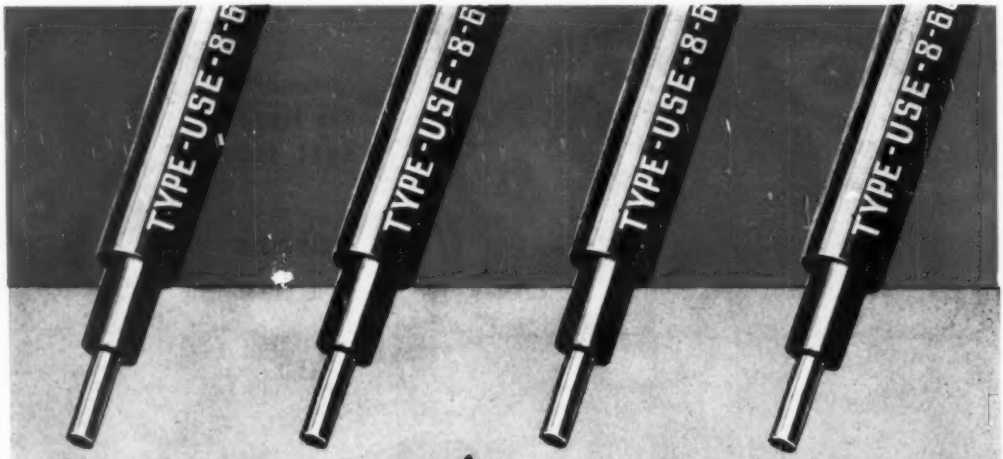

Go Underground— with **CRESCENT**

IMPERVEX TRENCHWIRE

For Lowest Cost, Permanent Installation

— Designed for Direct Burial in the Ground Without Additional Protection

You can recommend it and use it for services from power line to meter, for connecting several buildings from the same service, as on FARMS, ESTATES, INSTITUTIONS and for STREET, BALL-PARK, DRIVE-IN THEATRE and other outdoor lighting and power circuits.

It is approved for AIRPORT LIGHTING as Type "A" under CCA Specification L-824 for 600 volts.

Tens of millions of feet have been installed over the last twelve years under widely varying conditions — with an outstanding record of *dependability*.

Send Now For Bulletin No. 491
It Gives Complete Information

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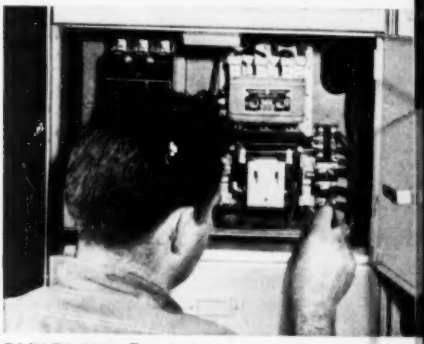
WIRE & CABLE

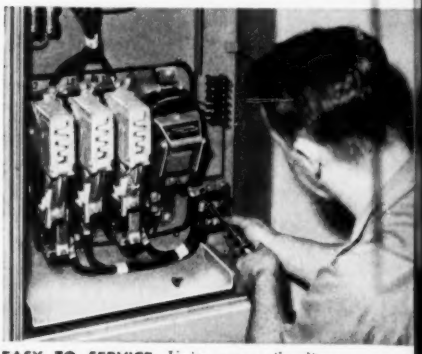
OVER 70 YEARS EXPERIENCE

CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, NEW JERSEY

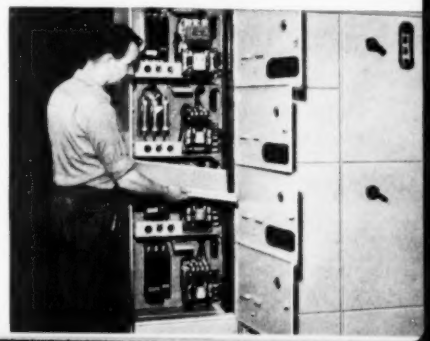
EASY TO INSTALL AND INSPECT. Interchangeable units; main bus completely accessible; incoming line connections are easily made.



EASY TO WIRE. Four-inch wiring trough; components accessible from all sides; front-connected starters; doors swing more than 90°.



EASY TO SERVICE. Units are easily disconnected from bus and locked in test position (above). Barriers between units are easily removed to facilitate wiring (below).



FORD MOTOR COMPANY OFFICIALS INSPECT THE INTERCHANGEABLE UNITS OF THE . . .

New G-E Motor Control Center

Since January, over 10,000 men from production and management of leading industries (see above) have taken a thorough look at the latest equipment for the centralized control of a-c motors up to 200 hp. Their reports indicate enthusiastic approval of what they saw. Here's why:

VERSATILE. Because units are easily interchangeable without waste space, a variety of arrangements can be made. For example—two Size 1 or 2 starter units require the same space as a Size 1, 2, or 3 reversing starter.

ACCESSIBLE. A four-inch continuous wiring trough provides ample wiring space. Components are mounted on an easy-to-handle frame and accessible from all sides when lifted from cabinet. Starters are front-connected. Master terminal boards can be swung out of compartment for extra working space around conduit.

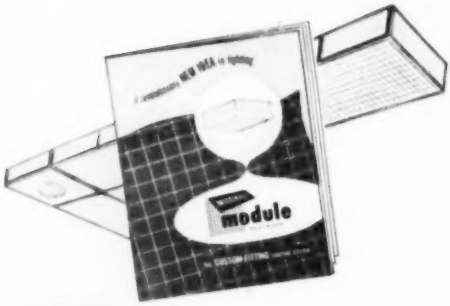
PROTECTED. Will withstand 25,000 amperes RMS short-circuit current, substantiated by certified Laboratory tests.

For more information on this new G-E motor control center, contact your nearest G-E apparatus sales office or write for Bulletin GEA-4979A today. *General Electric Company, Schenectady 5, N. Y.* 730-42

GENERAL ELECTRIC

easiest to specify, easiest to install, easiest to sell

America's most **complete** Quality Lighting Line



MITCHELL **module** CUSTOM-FITTING LIGHTING

The revolutionary lighting system for commercial interiors. Forms unlimited patterns—delivers 20% MORE LIGHT—installs quickly and economically—offers enduring beauty. Four basic "building blocks of light" CUSTOM-FIT any commercial interior at no more than the cost of ordinary fixtures. For full details, ask for Catalogs No. 360 and No. 370.

MITCHELL

COMMERCIAL FLUORESCENT LIGHTING

MITCHELL offers 70 superb Commercial Luminaires to meet the requirements of every conceivable installation: stores, offices, schools, institutions. You can specify MITCHELL Luminaires with confidence—they're tops for quality, time-saving installation, low-cost maintenance and lighting efficiency. Ask for Catalog No. 433.

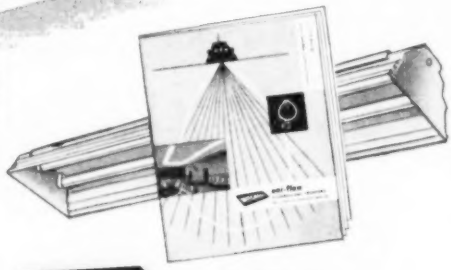
MITCHELL

EVERYTHING IN LIGHTING FROM ONE DEPENDABLE SOURCE

MITCHELL **DYNALITE**

Job-rated Lighting for Industry

You'll find it easy to specify for any industrial application when you choose from the complete line of 82 DYNALITE units. Available in all lengths and lamp types, with choice of reflectors and shielding. There's a DYNALITE that's PRODUCTION-RIGHT for every job. Full details in Catalog No. 438.



MITCHELL ***uni-flow***

Fluorescent Recessed Lighting

Here's the latest and finest achievement in recessed lighting: 6 different troffer lengths (shallow or deep); 12 types of shielding; 7 types of lamps; choice of reflectors—PLUS exclusive ONE-MAN installation feature that cuts installing time by 50%! The complete facts are in Catalog No. 605.

It's easy to specify, easy to sell from MITCHELL'S "tell-all" Catalogs covering Everything in Lighting. Write for them today.

MITCHELL MANUFACTURING COMPANY
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ALECTRAL®

ALUMINUM WIRES AND CABLES

NEW FREE BOOKLET!

Recent events and the outlook for the foreseeable future tend to focus greater attention on aluminum as an alternate to copper conductors. General Cable as a pioneer and major producer of Bare and Insulated Aluminum Wire and Cable is peculiarly fitted to service the industry with both aluminum and copper. They have assembled in compact form the principal data re: bare, weatherproof aluminum and ACSR line wires and service drop cables. Write today on your company letterhead for your copy of this booklet.

GENERAL CABLE
CORPORATION

EXECUTIVE OFFICES: 420 LEXINGTON AVENUE, NEW YORK, NEW YORK • SALES OFFICES IN PRINCIPAL CITIES OF THE UNITED STATES

It Shouldn't Happen to a Dawg

By BILL CRAMER

YOU LEAVE A LIGHTING INSTALLATION WITH A CLIENT— BUT BOY! OH BOY! WHAT A MAINTENANCE PROBLEM YOU LEAVE TOO!
"WHAT WE NEED IS A PLUMBER TO GET THESE [illegible] ENCLOSURES OFF!"
"IS THIS A LIGHTING FIXTURE OR A GUILLOTINE? THESE RAW GLASS EDGES ARE MURDER!"
"HOW ABOUT TNT? THAT IS IF WE CAN USE IT ON THE CONTRACTOR, TOO!"
"SO THESE ARE THE FIXTURES YOU SAID WOULD BE EASY TO TAKE CARE OF! WHY - IT'S A MAJOR PROJECT JUST TO RELAMP ONE!"
"THAT'S THE FOURTH CASUALTY THIS WEEK. LET'S ALL PUT IN FOR PURPLE HEARTS"

Sell Day-Brite Quality

. . . and this will never happen to you

Avoid customer ill-will and lost time and money due to needless "call backs." Sell Day-Brite quality —it's the one line you *know* will do a top-notch lighting job . . . with a minimum of maintenance problems.

Day-Brite maintenance features—snap-on enclosures, separable hinging arrangements, service chains on louver assemblies, all glass edges protected by steel frames, long-lasting baked-on finishes, best quality sockets and ballasts—guarantee easy cleaning and relamping.

You'll find, too, that Day-Brite lighting fixtures are easier and quicker to install—that puts more profits in your pocket right from the start!

Selling quality—Day-Brite quality—always pays off. For details, just write Day-Brite Lighting, Inc., 5402 Bulwer Ave., St. Louis 7, Mo. In Canada: Amalgamated Electric Corp., Ltd., Toronto 6, Ontario.

In the Famous Day-Brite Line • *the Viz-Aid*® • *the Plexoline*® • *the Lenes*® • *the Luxes*® • *the Ranger*® • *the P.B.M.* • *the Day-Line*® • *the Tur-A-Top*® • *the Duo-Frame* • *a complete line of troffers* • *exit signs* • *wallcase, showcase and fitting room fixtures* • *light strip.*

"DECIDEDLY BETTER"
DAY-BRITE
Lighting Fixtures

®

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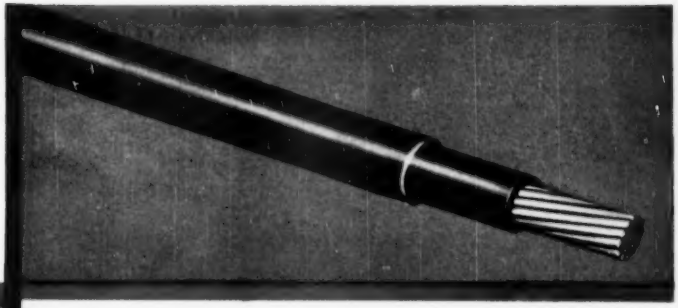

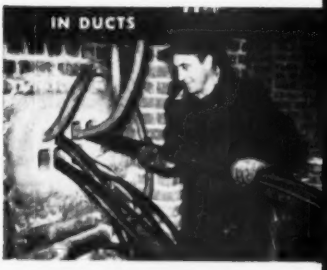

You can depend on neoprene-jacketed cable in all types of service

RURAL • RESIDENTIAL • INDUSTRIAL

Wherever it's installed, neoprene-jacketed cable gives long, trouble-free service. Above ground, neoprene-jacketed cable outperforms other types because of its unequaled resistance to deterioration from sunlight and weathering. In heavily industrialized areas, neoprene stands up in corrosive atmospheres . . . is ideal protection for both primary and secondary power cable.

Underground, buried direct or installed in ducts, neoprene resists attack from soil acids. Unlike metallic coverings, it is not damaged by electrolytic action caused by stray currents.

Cable manufacturers supply neoprene-jacketed cable in single and multiple conductor types in a range of voltage ratings. Since the same cable is often suitable for different uses, lower inventories are possible. And remember, a neoprene jacket assures longer life, fewer repairs, less frequent replacement even in the most severe service. E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division I'-12, Wilmington 98, Del.

NEOPRENE

The rubber made by Du Pont since 1932

DU PONT

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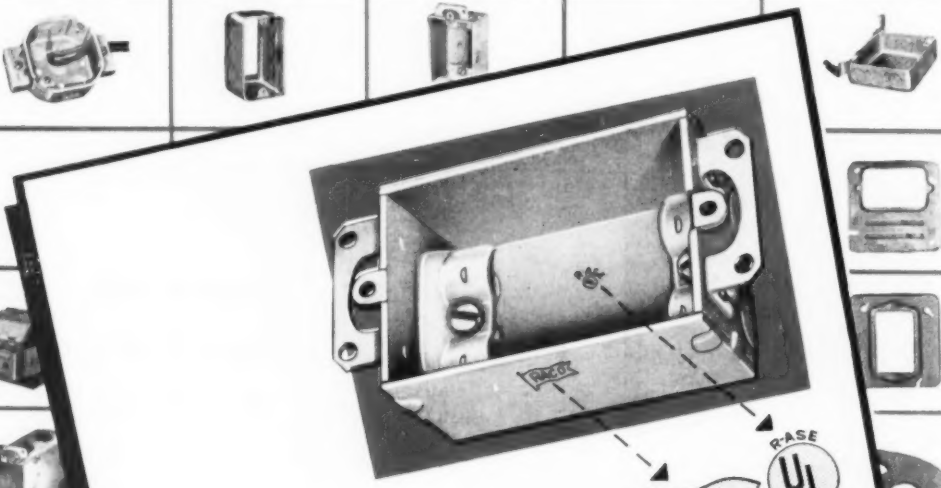
150th Anniversary

Tune in Du Pont "Cavalcade of America"—Tuesday evenings, NBC—coast to coast



What these two signs mean to YOU

RACO

R-ASE UL

The sign of the Underwriters' Laboratories "U-L" stamped on an electrical box means that it has passed the exacting safety examination of that organization and thus will meet the requirements of your local building code. The RACO emblem on a box means that it was designed and is constantly improved to make installation faster, easier, and permanent. This well-known trade-mark on box materials is your assurance that they are adaptable to all wiring needs . . . are handy to use . . . are recognized by architects, engineers, and builders everywhere . . . and are available nation-wide. Look for these two signs . . . insist on them!

You can always rely on RACO

RACO

ALL-STEEL EQUIPMENT Inc.—800 Kensington Ave., Aurora, Illinois

"A BOX FOR EVERY NEED"

Chairs or Chocolates...

Crown Furniture Co. Skylike provides an easily-maintained, high-level incandescent lighting system for the Crown Furniture Company's new Detroit store. 100 foot candles were required to overcome the daylight pouring in both glass-walled ends of the showroom, yet individual area intensities may be modified for special effects by simply changing lamp sizes. Floor-level relamping with pole-type changers offers maintenance savings by eliminating the use of ladders or disturbing the floor displays.

SKYLIKE lighting shows off merchandise at its selling best.

Loft Candy Shops — As a part of its progressive modernization program, Loft has specified Skylike units as the primary light source in its stores. Experience showed that incandescent light presented its fine chocolates and other candies in the most appealing manner. Careful tests were made by Loft executives to assure them that Skylike's diffused radiation eliminated the heat problem at the display level. The view at left is of Loft's new White Plains store.

How SKYLIKE blends 2 types of Lighting Units into 1

SKYLIKE systems for stores are flexible and easy to plan. Modular 24" x 24" units can be recessed, semi-recessed, or surface mounted. They require low initial investment, too — cost only ½ to ⅓ as much as other equipment delivering comparable results.

Note these additional SKYLIKE advantages: high-maintained light output; softly diffused shadows; warm color values; instant starting; floor-service re-lamping; variable lamp size (150-to 500-watt).

Try SKYLIKE on your next lighting installation.

1. Soft, indirect light from silvered-bowl incandescent lamps ...

2. The modern look of fluorescent-type troffers.

SEND FOR COMPLETE DETAILS

SKYLIKE LIGHTING, INC. — A Silvray-associated company
101 West Main Street, Bound Brook, New Jersey

Gentlemen:

Please send me further information on Skylike lighting.

Name _____

Firm _____

Address _____

City _____ Zone _____ State _____

NEW! Type NPLAB plug-in breaker panelboard...

One basic unit meets majority of lighting and appliance branch circuit application requirements without special adaptation

NOW, WESTINGHOUSE OFFERS YOU . . .

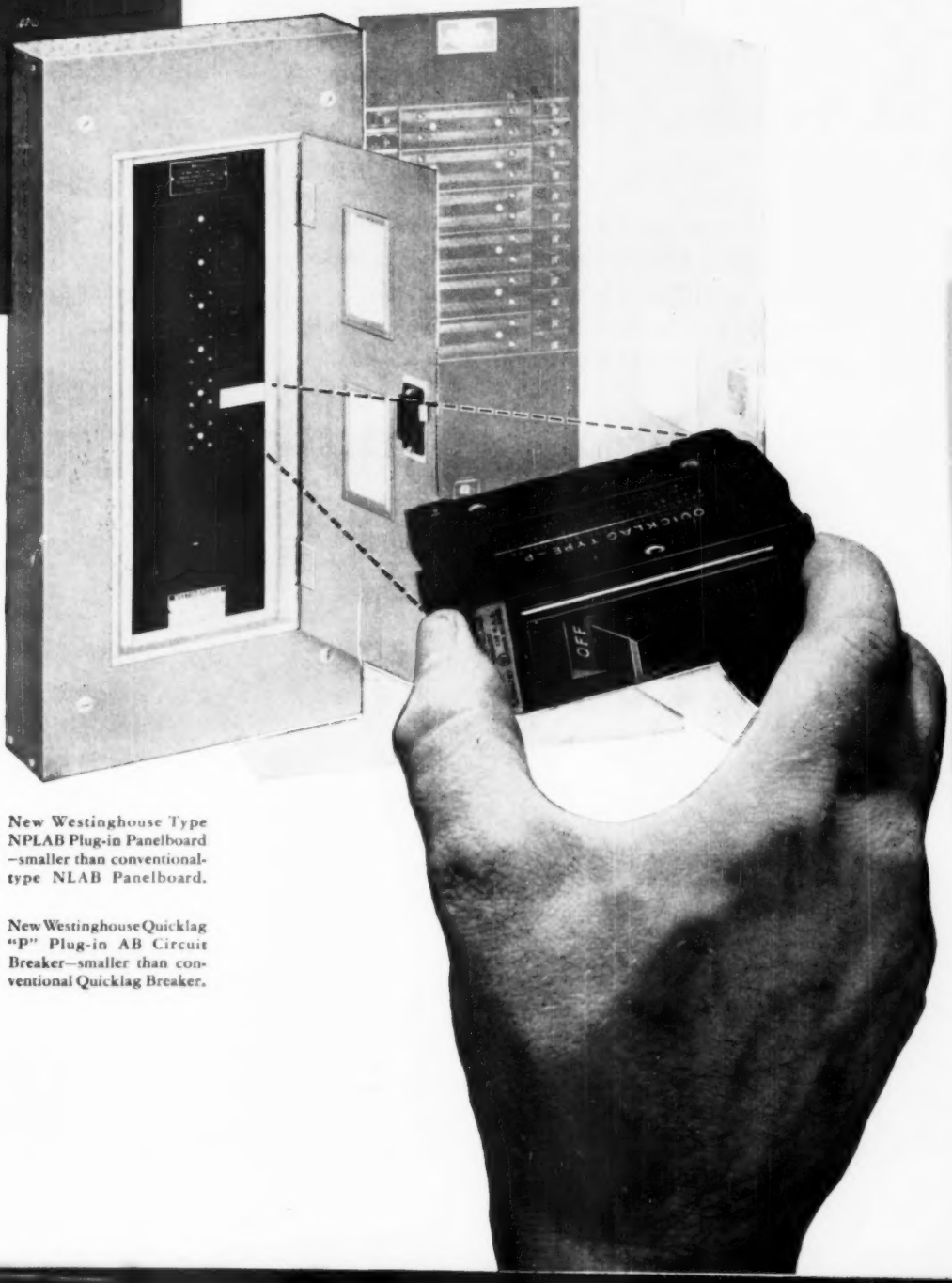
1. Industry's first Thermal Magnetic "De-ion" Plug-in Quicklag® Circuit Breaker—superior protection, proved efficiency.
2. Available for 1-phase, 3-wire, 115/230-volt SN, 3-phase, 4-wire, 120/208-volt SN services with 15 to 50-ampere, 1 pole branch breakers. (2 pole independent trip branch breakers available by adding handle extensions to two 1 pole breakers.)
3. Quick-make, quick-break action—fast, positive, safe.
4. New circuit breaker smaller than conventional Quicklag types—saves critical panel space.
5. New Type NPLAB Plug-in Panelboard smaller than conventional-type NLAB Panelboards—reduces job costs.
6. Permanent visible-phase identification on 3-phase, 4-wire panelboards, during and after installation; no guessing about load balancing.
7. Snap-on covers for neutral bar and main breaker—real time savers.
8. Rigid mounting of panel chassis assembly—offers a lifetime of protection against misalignment, breakage, accidents.

Westinghouse Type NPLAB Plug-in Panelboards have the flexibility, in one basic unit of standard design, to meet the majority of lighting and appliance branch circuit requirements with minimum engineering or special construction. Where else can you buy economical "De-ion" AB Circuit Breaker protection, fully pre-assembled into Westinghouse quality-built Panelboards?

Get in touch with your Westinghouse Representative, or write for B-5644, Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa. J-93486

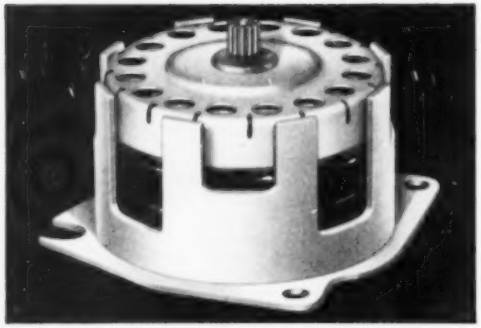
YOU CAN BE SURE...IF IT'S
Westinghouse

"DE-ION" BREAKER PANELBOARDS



New Westinghouse Type NPLAB Plug-in Panelboard —smaller than conventional-type NLAB Panelboard.

New Westinghouse Quicklag "P" Plug-in AB Circuit Breaker—smaller than conventional Quicklag Breaker.



Dependable motor performance under the most severe temperature variations

Sangamo Time Switches are accurate, quiet, and dependable because they are powered by the slow-speed, long-life Sangamo built motor. Operating at only 450 r.p.m., this motor minimizes bearing wear and consequently will give more years of attention-free service. A special silicon lubricant for the motor bearings affords lifetime lubrication and continuous operation under the most severe temperature variations.

Sangamo Time Switches Last Longer!

While the motor is, unquestionably, the heart of any time switch, the contacts, the opening and closing mechanism, and the enclosing case of Sangamo Time Switches—all contribute vitally toward their dependability and long life. Sangamo Heavy-Duty Time Switches have these important features:

LIFETIME LUBRICATION

A special silicone grease assures perfect operation in a temperature range from 50 degrees F. below zero to 200 degrees F. above. No special motor coils are required even in the coldest weather.

PRECISION GEARS

The heavy gears are precision made. They transmit the power to the dial smoothly and possess strength in excess of any service requirements.

OVERSIZE SILVER CONTACTS

The pure silver contacts are very conservatively rated and minimize troublesome arcing by combining a slow break action with a small gap.

COMPLETE DUST PROTECTION

Besides the enclosing case, the timing mechanism is protected by an additional dust cover which seals the motor and gears from contamination.

SANGAMO
ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

5152-9 *Get the full story...Write for Catalog No. 1010A*

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EQUIPMENT "Stands up" UNDER . . .

"TRIANGLE TESTING"

ROSELAND (N. J.) SWITCHING STATION OF PUBLIC SERVICE ELECTRIC & GAS COMPANY
220 KV
ROLLER-SMITH "ON THE LINE" TEST STATION
SIEGFRIED (PA.) SUBSTATION OF PENNSYLVANIA POWER & LIGHT COMPANY.
66 KV
220 KV
220 KV
PLYMOUTH MEETING (PA.) SUBSTATION OF PHILADELPHIA ELECTRIC COMPANY

When you purchase Roller-Smith and Elpeco equipment you are *assured* of perfect performance and extreme durability. Before any design is finally approved, both development models and production units are tested in accordance with applicable standards. Interrupting capacity and high current testing is done "in the field" under conditions of system stability exceeding those encountered under normal service conditions. The Roller-Smith Test Station, located directly adjacent to the Siegfried Substation, receives power at 66 KV from the 220 KV transmission system forming the Siegfried-Roseland-Plymouth Meeting "Triangle." Testing in this manner, rather than simulating the power conditions, insures your getting "more for your money" when you specify and buy—Roller-Smith and Elpeco.

ROLLER SMITH

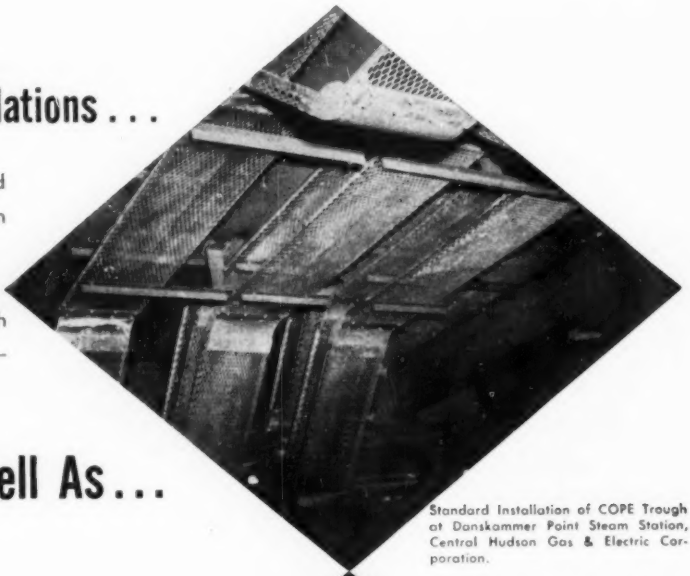
ROLLER-SMITH CORPORATION AND ELPECO DIVISION

BETHLEHEM, PENNSYLVANIA

ELPECO

For Most Cable Trough Installations . . .

Our exhaustive list of standard COPE Cable Trough parts can easily be worked into your plans. The simplified design of standard COPE Cable Trough actually saves you three ways — materials, labor and costs.



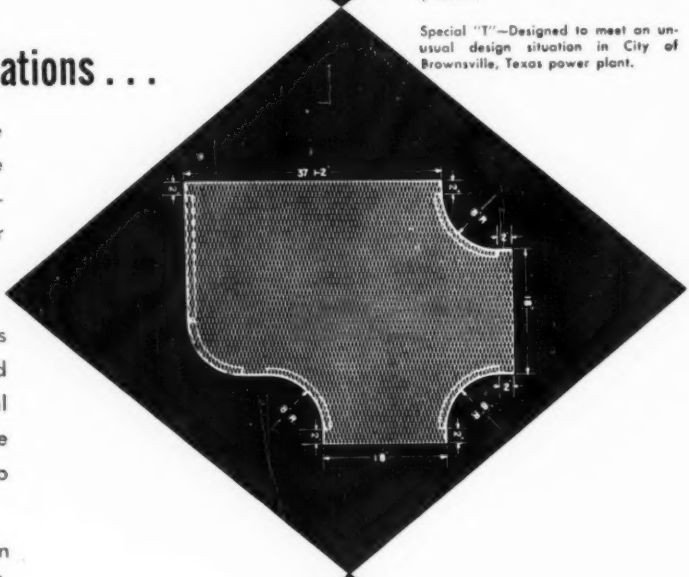
Standard Installation of COPE Trough at Danskammer Point Steam Station, Central Hudson Gas & Electric Corporation.

As Well As . . .

For Unusual Cable Trough Installations . . .

Where the standard COPE Cable Trough cannot answer those "special situations," COPE Engineers will help you with your problem. We will, as we have for hundreds of users, furnish special fittings. All we require is an outline of your problem and we will then design any special fittings necessary to adapt the standard COPE Cable Trough to your specific job.

Please request full information on standard COPE Cable Trough from us today.

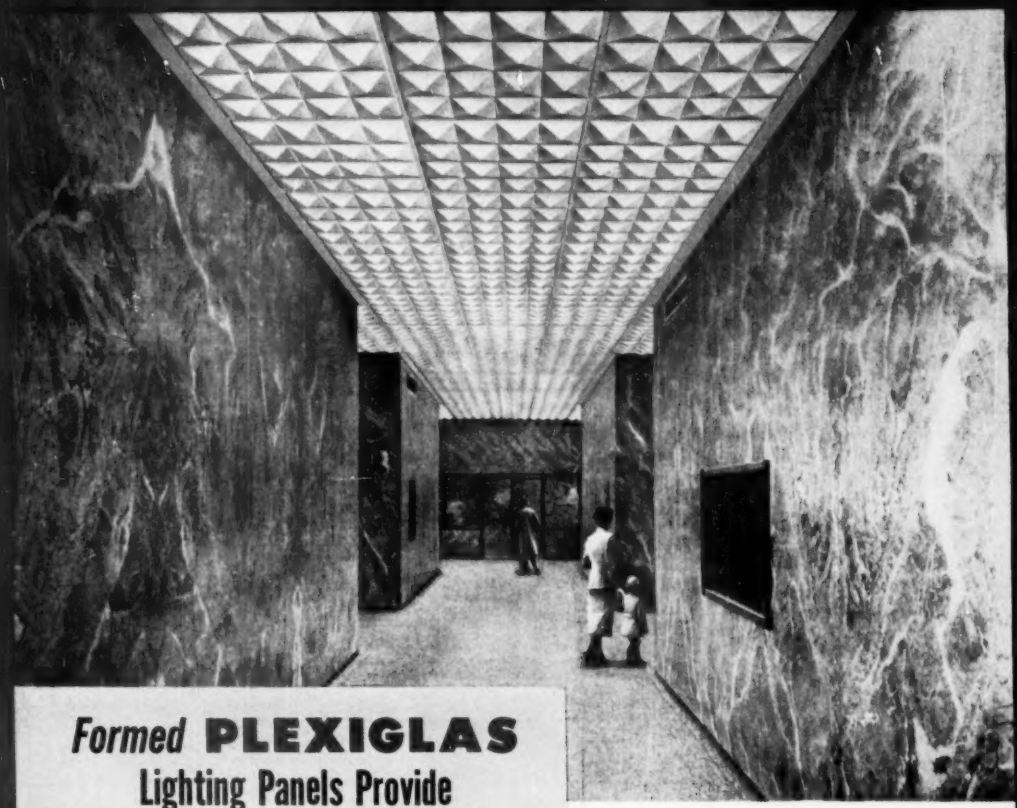


Special "T"—Designed to meet an unusual design situation in City of Brownsville, Texas power plant.

T. J. COPE, INC., 711 SOUTH 50th ST.
PHILADELPHIA 43, PENNSYLVANIA

T. J. Cope INC.

You know Cope by these products



Formed PLEXIGLAS Lighting Panels Provide Decorative Appeal at Gateway Center

All lobby corridors of the Gateway Center buildings in Pittsburgh are lighted as shown above, by custom-formed panels of PLEXIGLAS acrylic plastic suspended beneath cold cathode tubes.

The architects wanted a faceted ceiling design that would give sparkling texture to the lighting. The designer achieved this by having multiple pyramids formed into each acrylic plastic panel; mounted wall to wall along the corridors, the panels contribute marked decorative appeal to the lighting installation.

Thermoplastic PLEXIGLAS panels can be formed easily to almost any shape or design. This makes it possible to combine lighting with decorative treatments of ceilings—frequently at substantial cost savings. In addition there are the advantages of diffused illumination, low brightness ratios, and fixture-free appearance.

We will be glad to send you design details of the luminous ceiling shown above.

Gateway Center, Pittsburgh, Pa.—a trio of steel-clad office towers erected by the Equitable Life Assurance Society as part of the city's famed redevelopment program. Approximately 11,000 square feet of PLEXIGLAS diffusing panels are used for luminous ceilings in lobby corridors.

Architects:
Irwin Clavan and Eggers & Higgins, New York

Builder:
Starret Bros. and Eken, New York

Lighting Design:
Lighting by Feder, New York

PLEXIGLAS Fabrication:
Dura Plastics, Inc., New York

PLEXIGLAS *is a trademark, Reg. U. S. Pat. Off. and other principal countries of the Western Hemisphere.*

Canadian Distributor: *Crystal Glass & Plastics, Ltd., 130 Queen's Quay at Jarvis Street, Toronto, Ontario, Canada.*

CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

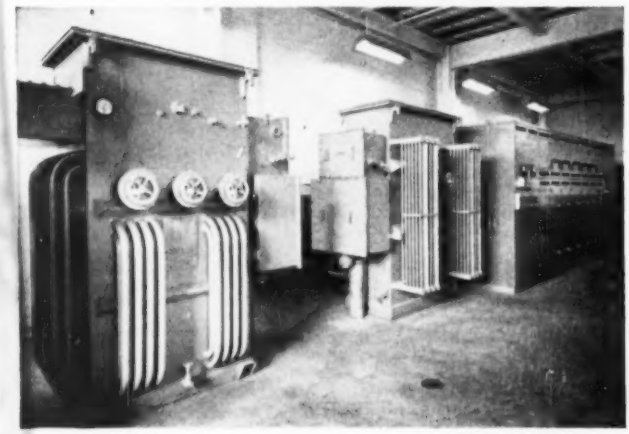
WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

Wagner
TRANSFORMERS
... the choice of leaders in industry

Wagner Unit Substation Transformers serve American Tobacco

One of the two double-ended unit substations equipped with 750 kva non-inflammable liquid filled Wagner transformers.



One of the two single-ended unit substations in this plant. All transformers are 13800 to 240 volts, 3 phase, 60 cycle.

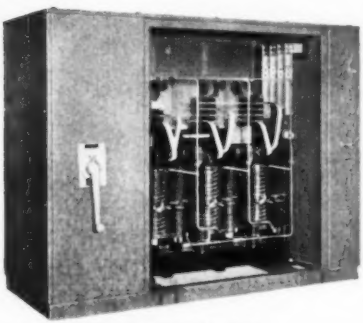
Two double-ended and two single-ended unit substations furnish power for all operations at Louisville plant...

Seven Wagner Unit Substation Transformers are used in the load-center power distribution system in the American Tobacco Company plant at Louisville, Kentucky.

The system is formed of two identical installations—each consisting of a double-ended unit substation equipped with two Wagner 750 kva Noflamol transformers, and a single-ended unit substation with a Wagner 500 kva Noflamol transformer. Another 500 kva Wagner transformer is installed in the boiler room of the plant.

This installation furnishes power for lighting and for all operations, including the humidity control that is so important in the manufacture of cigarettes.

Wagner Unit Substation Transformers are carefully designed to meet your distribution requirements. Oil-filled and non-inflammable liquid filled (Noflamol) transformers are available with various types of entrances and controls for the high-voltage circuits, and with proper throats on the secondary side to connect to any make of switchgear.



Dry-Type Indoor Transformers

Wagner three-phase dry-type load-center transformers are built in ratings through 2000 kva in the 15-kv class and below. Transformer and incoming line section are housed in compact factory-matched enclosures that are connected to matching secondary switchgear to form a closely coupled unit substation that affords ready accessibility. Bulletins TU-56 and TU-13 give full information. Write for your copies.

Wagner
Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6413 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS – AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

T52-10

NOW...longer lamp life at no extra cost

Important discovery in ballast design now gives *lead-lag* dependability at series ballast prices, sizes and weights. You get: maximum lamp life, stroboscopic correction, better maintenance in *all Westinghouse slimline luminaires.* Forget about lamp replacement guesswork—be sure of full-rated lamp life, and specify the new Westinghouse slimline with *lead-lag* ballasts. Get the complete story, B-5615, Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Penna.

J-04519

YOU CAN BE SURE...IF IT'S

Westinghouse

LIGHTING DIVISION

Edgewater Park, Cleveland, Ohio

SEALTITE

First flexible conduit to gain UL approval for wet spots

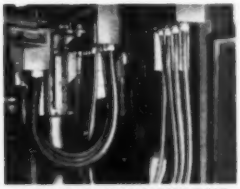
Industry after industry has adopted flexible *and* liquid-tight SEALTITE* electrical conduit. They have used it successfully to protect wiring from moisture—outdoors or indoors. They have used it where movement, vibration, misalignment, cramped quarters, or installation time are problems. In addition, they have made impressive savings in maintenance.

Now new SEALTITE Type UA is the *first* flexible, liquid-tight conduit to be *approved by Underwriters' Laboratories, Inc.* It has met their rigid tests for a conduit that, while retaining remarkable flexibility, guards wiring against corrosive moisture and mineral oils (up to 60 C). SEALTITE Type UA conforms with provisions of Article 351 of the National Electrical Code under "Liquid-Tight Flexible Metal Conduit." 52241

*Trademark

specify SEALTITE Type UA for

WET LOCATIONS



MOVING CONNECTIONS

OUTDOOR PROTECTION

MISALIGNMENT

Write for Bulletin UA-530 on UL-approved SEALTITE. Leading electrical supply houses stock SEALTITE Type UA in long random lengths. You can cut it as needed without waste. Underwriters' Approved Connectors for use with SEALTITE are also available at your electrical supply house. The American Brass Company, American Metal Hose Branch, Waterbury 20, Connecticut. In Canada: The Canadian Fairbanks-Morse Company, Ltd.

A JIC-approved SEALTITE Type EF is also available. Write for Booklet EF-531.

for flexible, liquid-tight electrical conduit—specify SEALTITE an ANACONDA® product

Washington Report

Future planning has been at a standstill in Washington since the November election, promises to revive slowly now that Eisenhower has completed most of his new Cabinet appointments.

What happens to defense mobilization agencies now depends on the 83rd Congress. Under the DP Act still in effect, price-wage controls are extended to April 30, materials controls to June 30. Direct credit controls are already gone. Price decontrol is under way, but scarce metals will be kept under price control as long as possible. Materials allocations become less necessary as steel, copper, and aluminum become adequate for all needs. This balance is now predicted for some time next spring.

NPA's Controlled Materials Plan may continue. Some sort of allocation system will be needed for scarce alloying metals for a long time. The military wants a framework for metals controls continued in case of a new emergency. Also, in a recent NPA survey of IA Committee members, nearly all expressed favor of continuation of CMP in some limited form.

Record rate of steel production is relieving shortages, may permit steel decontrol before expiration of the Defense Production Act next June. DPA increased steel allotments for first quarter 1953 by 1.48-million tons of carbon steel products, of which NPA's Electrical Equipment Division gets 20,750 tons. This is in addition to former advance allotments totaling about 60% of 3rd quarter 1952 usage previously allotted.

Copper is temporarily in tight supply, according to NPA allocators, due principally to price differential between domestic and foreign supply and to a strike in Rhodesia mines forcing Britain to buy from Chile, main source for U. S. importers.

Aluminum production was down about 10% in September, due to power curtailment in Pacific Northwest forced by dry weather. But aluminum supply is adequate, and expected to increase monthly during 1953.

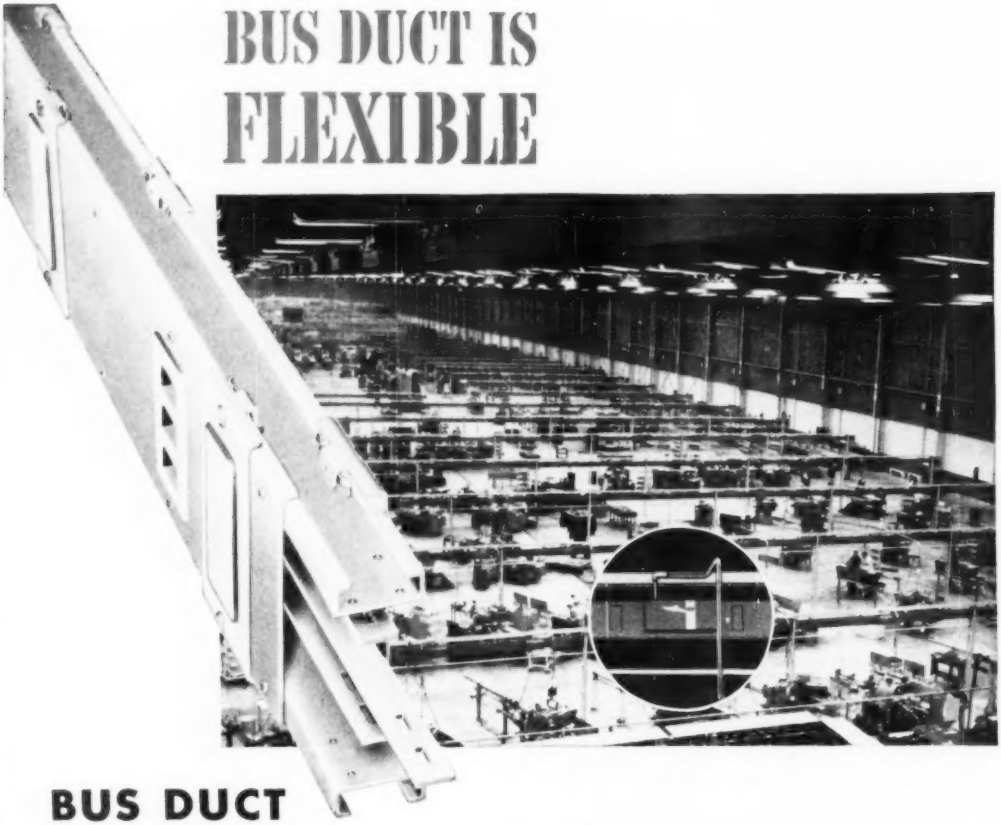
Copper wire and cable producers recently recommended to NPA through a task group that copper controls be relaxed immediately, reporting that from July to November inclusive refined copper available for allocation by NPA to all users has been about 128,000 tons monthly. Demands are now about 120,000 tons monthly, they said. November allocations to the wire-mill industry was about 65,000 tons of which nearly half was foreign copper.

Producers of fractional hp motors told NPA through their Industry Advisory Committee members recently that makers of household appliances have an ever-increasing demand for small motors, boosting their need for supplemental allotments of copper wire-mill products. NPA forecast a continued tight supply of these products, with steel continued tight at least through next year's first quarter, and commented that appliance maker's demands may be unrealistic—their 1953 production estimates may be over-optimistic.

New construction in 1953 is now expected to total about $32-billion, equal to this year's record level. Public construction of non-residential building and highways next year will show greatest increases, offsetting possible declines in private industrial and public residential. (Detailed analysis of estimated 1953 new construction will appear in EC&M, January, 1953).

Home building starts in October were 101,000, up 3,000 over September, 11,000 over October 1951. Total starts for first 10 months of 1952 are 966,400, over 10,000 starts ahead of similar period last year. Nearly all of the October starts were privately financed units.

BUS DUCT IS FLEXIBLE



BUS DUCT
solves high bay distribution problem

Mounting on angle iron standards proves highly flexible

An extremely high bay created a serious secondary power distribution problem at the Tulsa Plant of the Douglas Aircraft Company.

Douglas solved the problem uniquely, by mounting 4,600 feet of 400 ampere, 3-wire, 3-phase, Westinghouse Plug-In Bus Duct from angle iron standards resting on the floor. Unequaled plant layout flexibility resulted.

All Bus Duct runs are convenient to machines and exposed to view. They're mounted high enough to be out of the way, but low enough to plug in or service easily. (See circle inset.) No material is wasted with long, unnecessary lead-ins to machines; no time is lost checking circuit feeds. Machines can be shifted without affecting Duct.

Perhaps this manner of Bus Duct installation can be applied to solve a similar problem in your plant or building. Four types of Westinghouse Bus Duct are available for any service demand up to 5,000 amperes.

Get complete details from your Westinghouse Representative or write for B-4272-A, Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Penna.

J-30111

YOU CAN BE SURE...IF IT'S

Westinghouse

BUS DUCT

DECEMBER . . . . *at a Glance*

"Men At Work"

An on-the-job account of the highlights of electrical construction now underway at Philadelphia International Airport is presented on page 65. It's a roundup of job methods, installation techniques and equipment applications—made while the crew from The Howard P. Foley Company are still at work on this modern electrical project. Assistant Editor McPartland's camera has recorded some of the step-by-step working procedures and the more significant design elements, including an interesting electrical system for heating fuel oil fed to three oil fired boilers.

Bus Duct Feeders

Like nearly every other building 20 or more years old, Pittsburgh's Chamber of Commerce Building had woefully outgrown its old electrical distribution system. Something had to be done. So James Paul Warner, Pittsburgh consulting engineer, was called in to study this problem and recommend a solution. Bus duct feeders from basement to top floor and new distribution panels were recommended, and installation is now being completed. Mr. Warner discusses economic considerations and describes installation details in an article beginning on page 68.

Rapid-Start Fluorescent

Another fluorescent lighting development is the new Rapid-Start lamp and correlated ballast design. Involving a new circuit in which starters are eliminated, it is predicted this new lamp will eventually dominate the four-foot lamp market. C. J. Allen, G. E.'s School Lighting Specialist, describes this new development and the first major installation in a Wisconsin school system, in an article beginning on page 72.

Methods for Mass Wiring

Electrical contractor Charles A. Langlais of San Francisco recently wired a 200-acre integrated community project that included 3,483 separate apartment units, comprehensive shopping district, administration center, maintenance buildings and garages. The electrical scope is impressive. Yet even more significant are the methods used in connection with mass procurement of materials, field assembly of components, coordination of labor and communication between supervisory personnel. These methods, discussion by Langlais on page 74, contain several new and useful approaches to the solutions of mass construction problems.

60 Years

Though none of the original band of pioneers who formed the New York Electrical Contractors Association were there, President Harold A. Webster and 500 members and guests who have followed in their footsteps were on hand to honor them and to celebrate the Association's 60th birthday at the Waldorf-Astoria on November 1. Three of the founding firms are still in existence, Conduit Wiring Company, Hatzel & Buehler, Inc., and Alliance Electric Co.

Light and Architecture

Appropriately the Pacific Gas & Electric Co. in San Francisco has used light as a medium of design in one of their new substations. They combine fluorescent and incandescent light sources to light well-conceived exterior structural details and provide a most artistic nighttime effect. Eastern Editor Berlon C. Cooper describes this installation in detail on page 80.

DATES AHEAD

American Institute of Electrical Engineers—Winter general meeting, New York, N. Y., January 19-23.

Plant Maintenance Show—Public Auditorium, Cleveland, Ohio, January 19-22.

Electrical Industry Convention—Nicollet Hotel, Minneapolis, Minn., March 8-11.

National Electrical Manufacturers Assn.—Edgewater Beach Hotel, Chicago, Ill., March 9-12.

Industrial Electrical Exposition—Sponsored by Essex Electrical League, Terrace Room, Newark, N. J., March 10-13.

Edison Electric Institute—Annual sales conference, Edgewater Beach Hotel, Chicago, Ill., March 30-April 2.

Chicago Electrical Industry Show—Sponsored by the Electric Association and the Electrical Maintenance Engineers of Chicago, Conrad Hilton Hotel, Chicago, May 11-14.

National Fire Protection Association—Edgewater Beach Hotel, Chicago, Ill., May 11-15.

National Industrial Service Association—Annual convention, Hotel Statler, New York City, May 24-28.

National Association of Electrical Distributors—45th annual convention, Conrad Hilton Hotel, Chicago, Ill., May 24-28.

Edison Electric Institute—21st annual convention, Atlantic City, N. J., June 1-4.

American Institute of Electrical Engineers—Summer general meeting, Atlantic City, N. J., June 29-July 3.

Illuminating Engineering Society—Hotel Commodore, New York, N. Y., September 14-18.

International Association of Electrical Inspectors—25th Jubilee meeting, Edgewater Beach Hotel, Chicago, Ill., September 21-26.

Industrial Electric Exposition—Hotel William Penn, Pittsburgh, Pa., October 6-8.

Canadian Electrical Manufacturers Assn.—Annual meeting, General Brock Hotel, Niagara Falls, Ontario, Canada, September 23-25.

National Electrical Manufacturers Assn.—Haddon Hall Hotel, Atlantic City, N. J., November 9-12.

TOM POLGLASE of Anaconda receives 1st award from General Chairman A. S. Roberts at Chicago Industrial Packaging and Materials Handling Exposition.

PRIZE-WINNING
MOLDED SHIPPER

No problem plagues magnet-wire users more than damage to wire shipped in easily-broken wood boxes. Difficult to detect, even the slightest injury can conceivably impair the performance of finished windings.

Now a special fibre-molded case* protects wire spools from rough, tough handling in transit, stockroom and shop. Developed and used by Anaconda, this new container won top honors at the recent 7th Annual Exposition of the Society of Industrial Packaging and Materials Handling Engineers.

Made in identical halves, it has met severe tests . . . tests under which the best conventional wooden boxes burst. After one hundred 30-inch drops, the new case *still retained its wire spools in perfect shape.*

This molded shipper is ⅔ lighter, handles easier, stores in less space, nests compactly when empty. From factory to your workbench it safeguards the exceptional quality built into all ANACONDA Magnet Wire—Formvar, Enamel, Vitrotex† and the others. Ask for full details. Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

58356

the right magnet wire for the job

ANACONDA®

*patent applied for

†reg. U.S. Pat. Off.

OLD AND NEW. Here the new molded fibre containers carry the same wire weight as 24 wooden boxes.

←**TRAY-LIKE FIBRE CASE** is sturdy, handy, has no sharp corners, nail or sliver hazards. Top nests in bottom half . . . takes ⅓ the space of wooden empties.

ELECTRICAL CONSTRUCTION AND MAINTENANCE

52nd Year—DECEMBER • 1952

Root Strength

WIDESPREAD OPTIMISM on the business outlook for the coming months is evidently more than reaction to the election. Plans for capital expenditures for the next year, which have much to do with the outlook in electrical apparatus and wiring, approximate the '52 record. And the bulk of those plans were in the making long before the electorate reached its historic decision in November.

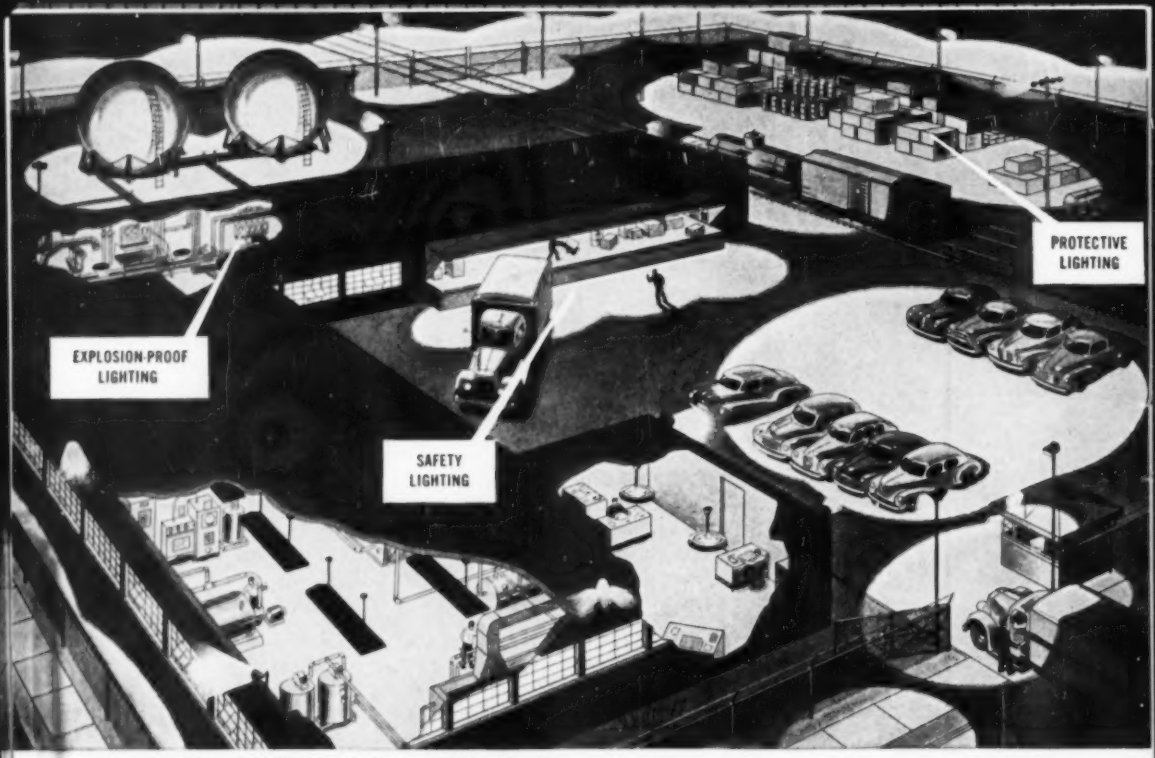
SO THERE IS CONSIDERABLE CONFIDENCE that good market potentials will be further blessed with good "business climate." In prosperous times the electrical industry inevitably prospers, but the test of its progress is a sustained high rate of growth with respect to the whole economy. It's a growth industry. Strong and aggressive market development is normal and the roots must go deep.

WARNING SIGNALS are inconspicuous in this business. They have to be looked for. Those cylinders behind that row of new houses, that's l-p gas. In that brand new office building the partitions aren't up, but the lighting is, all 30 footcandles of it. Notice that new highway intersection with four foot deep foundations, but no lights. These may seem little shortcomings, but they are all too typical symptoms worth pondering because each such case involved, at some time, a technical or business decision—and the electrical industry lost.

WE ARE HEADING into a new year with no industry program directed toward opening up the badly needed residential rewiring market. What influence obsolete wiring will have on the sale of modern electrical appliances is impossible to forecast. Highway lighting and street lighting modernization are years behind urgent needs. Electrical distribution systems are still subject to last minute trimming to satisfy skimpy building budgets. The list could go on, but the gap between obvious opportunity and what constitutes practical compromise on run-of-mine work today is too wide for complacence.

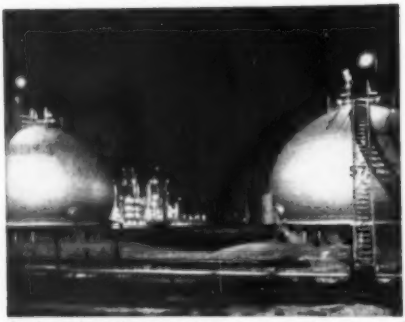
IF THE PROMISE of the future is to hold, the gap must be closed, not only by big engineering contractors on monumental projects, but on industrial alterations, on store modernization or house wiring. The roots of this great industry reach everywhere. Their strength depends on modern initiative and technology expressed in every possible electrical installation.

Wm. T. Stuart



PUT GRAYBAR'S LIGHTING EXPERIENCE TO WORK FOR YOU You can count on Graybar for accurate, helpful information on any of these typical lighting installations. We'll be glad to work with you in planning practical solutions to the more specialized applications of protective lighting, safety lighting, and explosion-proof lighting. The fixtures and wiring materials they require can be conveniently secured through your near-by Graybar office.

How to simplify complex lighting jobs



Lighting hazardous locations in refineries, chemical plants, and pumping stations, for example, requires specialized techniques. A Graybar Lighting Specialist can always help you select lighting units and fittings that provide maximum protection against the danger of explosion.

When the job's a tough one, call in your local Graybar Lighting Specialist. He's ready to help you and your customers develop tailor-made layouts for all types of protective or explosion-proof lighting installations.

But, no matter what the job—when it first comes up—*that's* the time to contact your Graybar Representative. Let *him* furnish the delivery, price, and specification data you need to make your bid. You'll get it fast, too, because Graybar people have this sort of information right at their fingertips. Later on, it's a simple matter to write out a single order for all the lamps, fixtures, wire, and fittings you need—saves you dollars both in time and paper work.

Remember, Graybar distributes over 100,000 different electrical items, including the most complete selection of lighting units and lamps available anywhere.

In fact, it pays to check with your local Graybar house for *everything electrical*—for wiring, power, ventilation, and communication, as well as lighting. 200-412

Graybar Electric Co., Inc.
Executive Offices: Graybar Building
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Get convenience, service, reliability . . . via GraybaR

IN OVER 100 PRINCIPAL CITIES

On The Job... AT PHILADELPHIA AIRPORT

A roundup of job methods, installation techniques and equipment applications—all part of the electrical construction now underway in the expansion and modernization of Philadelphia International Airport. The Howard P. Foley Company, electrical contractors.

By J. F. McPartland, Jr.

CONSTRUCTION of a new ultra-modern Terminal Building at Philadelphia International Airport provides the background for a case study in the details of modern electrical work. Today, as this building nears completion, it is a beehive of electrical construction activity. The following is an on-the-job account of some of this activity, including work methods, installation techniques and equipment applications. The electrical contractor is The Howard P. Foley Company, Philadelphia, Pa.

Methods and Techniques

Throughout the four levels of the Terminal Building and the two levels of the adjoining Boiler House, the various electrical jobs in the overall project are handled by teams of specialists. Depending upon the type of work involved, each job is broken down into a number of steps which are divided among the men on the team. With this kind of concentration on the details of a job, each man has his specific assignment down cold. Cutting, threading and bending conduit; assembling junction and outlet boxes with fittings and elbows; installing equipment and wiring devices are all continuous procedures, with as much pre-fabrication of assemblies as possible.

The installation of recessed incandescent lighting fixtures in the Baggage Room on the first level of the Terminal Building is typical of the work-flow procedures used. Here, the team coordinated in cutting and threading the rigid conduit; installing the conduit, boxes and other wiring devices; pre-assembling the recessed fixtures and flexible conduit tie-ins to the junction boxes; mounting the angle-iron fixture hangers and installing the fixtures.

One of the job methods used in this lighting installation was the assembly of the lighting boxes by two men on the team. Working at a bench set-up near the Baggage Room, each man performed several steps in the preparation of the fixture. One man concentrated on mounting fittings on the recessed box; the other prepared and connected the flexible conduit to the box.

Preparation of the flexible conduit was made while the fittings were being mounted on the box. The man on this part of the job would cut about ten pieces of insulated stranded wire to the required length, skin the ends and tin one end of each of the wires for connections to screw terminals. For tinning, he used a small bench set-up (Fig. 1) consisting of a lead pot suspended above the flame of a small torch (throw-away-cylinder type) and a cardboard wind shield. The stranded wire ends to be tinned were twisted tightly, dipped in a can of non-corroding soldering flux, then dipped in the lead pot. Pairs of the tinned wires were then pulled in short lengths of flexible conduit which had been pre-cut in a large quantity.

As soon as a number of wire-loaded lengths of the flexible conduit had been completed, they were connected to the lighting boxes which were ready for them. (Fig. 2) As it worked out, the operations of the two men on this

FIG. 1. Bench set-up for tinning wires consists of lead pot suspended above torch flame with cardboard windshield.

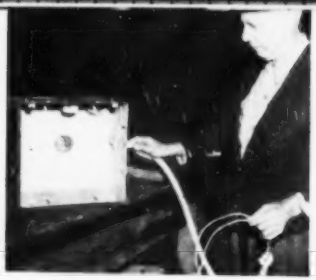


FIG. 2. Flexible conduit for tie-in to junction box was connected to lighting fixture during pre-assembly.

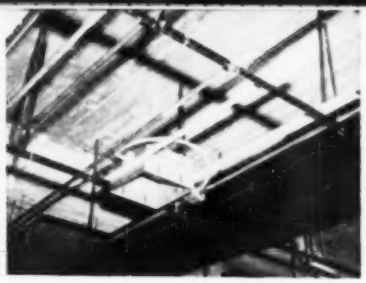


FIG. 3. Recessed incandescent lighting box was mounted on angle-iron hangers, boxes installed by team.

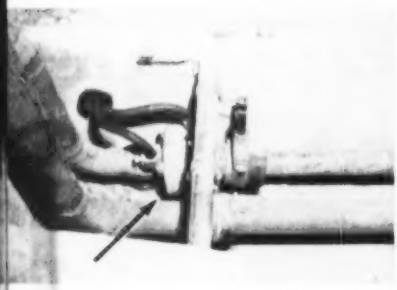


FIG. 7. Feeders from transformer secondary connected to terminals, one on each side of insulated union (Arrow).

FIG. 8. Thermostatic element (Arrow) inserted in oil suction line at building wall; return line alongside.

FIG. 9. Underfloor duct, junction box and conduit runs to telephone cabinets in future office area.

team were closely coordinated, and neither had to wait for the other to catch up to him. The assembled boxes were then passed along to the team which mounted them in their positions in the Baggage Room. (Fig. 3)

Similar efficiency of motion prevailed for the installation of bus duct hangers which will support a 1500-ampere bus duct run along a trucking corridor which runs the length of the Terminal Building. These bus duct hangers were mounted in a straight line and supported from 4-inch angle iron beams across the corridor. Hanger rods were fastened through the horizontal member of the angle beam, using retaining nuts on the threaded rod ends. With this type mounting, level hanging of the bus duct could be assured by simply adjusting the retaining nuts.

Speed and ease of installation of the hangers were effected by a team of two men using an assembly-line technique. First, a guide string was stretched along the corridor about two-feet below the ceiling, establishing the centerline of the bus duct run. Then one man climbed a ladder at one of the transverse angle-beams. Using a plumb bob, he plumbed on the guide string from the angle beam and made a centerline mark on the beam. Five inches on both sides of this centerline mark, he then chalk-marked locations for the hanger-rod holes. In a matter of seconds, the two holes were cut through the beam with an acetylene torch. (Fig. 4)

As soon as the first man had finished cutting the holes in one of the beams and had moved on to the next, the second man on the team mounted a ladder and fastened the bus duct hanger. (Fig. 5) He pushed the threaded ends of the hanger rods through the holes in the beams and screwed a retaining nut on each rod end. Using this procedure, the second man followed the first down the line of the bus duct run. This kind of teamwork and the torch cutting technique were also used for mounting pipe and conduit hangers.

Equipment Applications

Pointing up modern electrical design in the Terminal Building and the Boiler House are many applications of the latest types of equipment. This is evidenced in the use of plug-in bus duct distribution from the four transformer vaults on the first level of the Terminal Building, the equipment for providing emergency lighting and power, the extensive system of intercommunication and signalling equipment and the component parts of the electrical distribution system.

Typical of the modern equipment applications is the electrical system used to maintain proper temperature of the No. 6 fuel oil fed to three oil-fired boilers in the Boiler House. Here, the fuel oil for the boilers is pumped from a tank outside the building. To assure the proper viscosity of the oil for pumping, the oil must be maintained at a temperature of 120°. For this purpose, a system combining two methods of electrical heating is used.

Basically, the oil heating system consists of a resistance heating circuit through the oil pipes themselves, immersion heaters in the oil return line and the heating control panel. The system is so arranged that the oil in the suction line feeding the boilers is heated by current passing through a circuit of which both the suction and return lines are the conductors. Heating is the result of the I^2R losses and the hysteresis and eddy current losses in the pipe. The oil which is returned from the boilers to the outside tank is passed over the immersion elements.

On the control panel for the system (Fig. 6), a 6-kva step-down transformer powered at 230 volts is the current source for the resistance heating circuit. From the secondary of this

FIG. 4. Acetylene torch was used to cut holes in angle-iron beams for mounting bus duct hangers.

FIG. 5. Bus duct hanger rods were pushed through holes cut in beam and held by nuts on threaded rod ends.

FIG. 6. Control panel for oil heating system, showing transformer, disconnects and immersion heaters (Arrow).

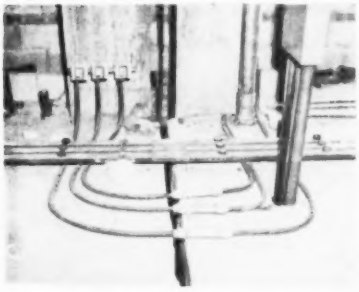


FIG. 10. Expansion couplings on underfloor duct and conduit runs which cross building expansion in floor.

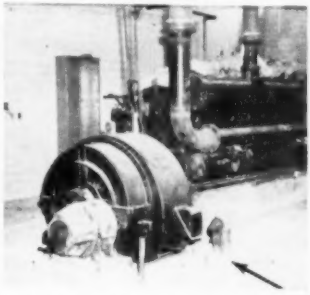


FIG. 11. Diesel-driven emergency generator, one of two, with stubbed-up conduit (Arrow) for emergency feeders.

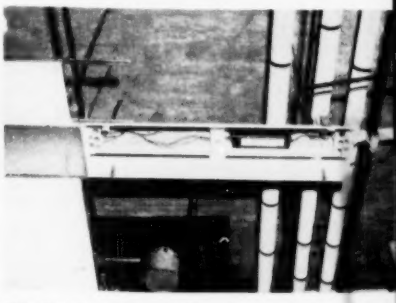


FIG. 12. Fluorescent troffers, in continuous row with diffusing glass shielding, installed in acoustical tile.

transformer, about 18 volts, the high current is fed to two terminals, one on each side of an electrically insulated union in the pipe line. (Fig. 7) From one of these secondary transformer feed terminals, a circuit is completed through one section of the return line, across a cable jumper to one section of the suction line, then back to the other side of the transformer secondary at the second terminal on the insulated union. Due to the length of the oil piping in the building, the run of pipes is divided into three sections with a closed resistance heating circuit, including separate transformer and control panel, for each section. Insulated pipe unions were used to form the three closed circuits for resistance heating. And because the pipes are used as electrical conductors, they are supported in their positions by insulated hangers.

The immersion heaters are located in the oil return line near the point at which the line leaves the building. These heaters, and the resistance heating circuits, are controlled by a thermostatic element inserted in the oil suction line at the point of entry. (Fig. 8) The thermostatic element measures the temperature of the incoming oil against the required minimum temperature. Through a relay on the control panel, the thermostat regulates the immersion heaters, increasing the heating of the return oil when the temperature of the incoming oil falls below a pre-set level. In this way, the effect of extremely cold weather on the oil viscosity is eliminated.

Another application, in widespread use throughout the Terminal Building, is that of underfloor duct. The advantage of this type of wiring is readily evident in one of the future office areas on the third level of the building. (Fig. 9) In this area, immediately below the airport control tower, the use of underflow duct with conduit tie-ins between junction boxes and the many telephone cabinets, panelboards and receptacles greatly facilitated the unusually heavy concentration of circuiting for lighting, telephones, intercom and signalling. Here, the complete underfloor duct-work was laid amidst the many conduit risers for power, lighting and signalling in the control tower above and crosses one of the seven expansions in the building. On all conduit and duct runs crossing expansion in floor, expansion couplings were used. (Fig. 10)

Provision for emergency power has been made with two diesel-driven 312 kva, 4160 volts, 3-phase generators in the Boiler House. (Fig. 11) These units feed a 5 kv, 3-phase, 3-wire bus in an outdoor substation behind the Boiler House and are equipped with automatic cutover upon failure of the normal service. The generators provide for emergency lighting to the Terminal Building, lighting and engine generator auxiliaries in the Boiler House and field lighting.

Modern lighting installations form still another part of the work in the Terminal Building. Two examples of the lighting techniques used are in the main lobby and the Airlines Executive Offices. In the main lobby, which is about 50 feet high, incandescent direct-type units are being mounted on disconnecting-and-lowering type hangers. The lowering chains and pulleys for these hangers are located within the lobby walls, with the chains run to a recessed cabinet from which the fixtures can be lowered. In the Airline Offices, continuous row fluorescent troffers have been installed in acoustical tile in part of the area, on a test basis. (Fig. 12) These units take two 48-inch F lamps and are shielded with ribbed glass.

Although this roundup has included only a few of the many methods and applications used on this job, it represents the overall approach to the electrical work now underway.

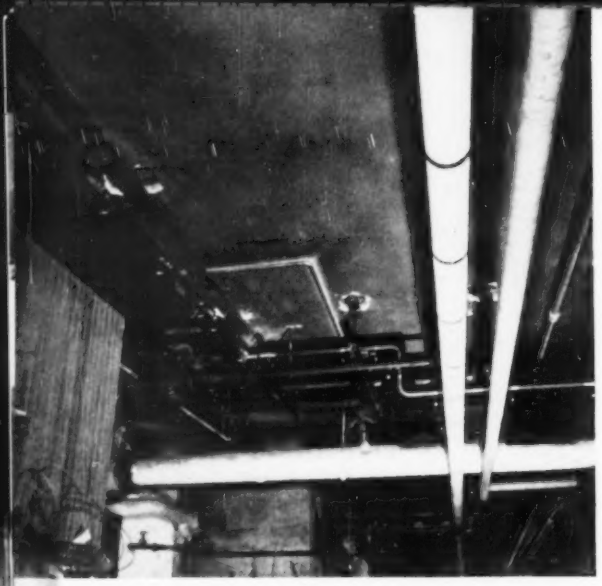


FIG 1—Unobstructed path for bus duct in congested basement ceiling area was determined with water-hose level. Basement runs are supported by hangers welded to building steel.

Increasing use of electrical utilization equipment overloads old distribution system in Pittsburgh's Chamber of Commerce Building, necessitates rewiring. Modern bus duct system with spare capacity was adopted and installed after detailed study and analysis.

By James Paul Warner, P.E.
Consulting Electrical Engineer
Pittsburgh, Pa.

Busway Modernizes Old Building

KEEPING pace with Pittsburgh's community improvement program, owners of the Chamber of Commerce Building are spending a quarter million dollars replacing its electrical wiring system. Overloaded by constantly increasing demands for more and better lighting, together with additional requirements for automatic business machines and air conditioning equipment, the distribution feeders and circuits had reached the point where the only solution remaining was to rip out the old and put in new.

Voltage drop at some lamps ran as high as 8 volts. On lighting units 1% drop in voltage results in a 3% loss in light output which, in this case, amounted to more than a 22% reduction in illumination. Added to this was the excessive power loss dissipated as heat in the conductors with its deteriorating effect on the insulation—both of which mean higher operating and maintenance costs.

The Chamber of Commerce Building is a 16-story, steel frame, brick exterior structure with elevator shafts in the center. The first floor is occupied by shops, and the floors above by offices. Average floor area is 18,900 square feet. Typical office floors were served by two electrical shafts, one at or near each end of the bank of elevators and each shaft served two branch circuit panels. This arrangement divided each floor into four rectangular sections, each fed by its own branch circuit panel. Tenant meters were exposed in the corridors.

Replacing the wiring in an occupied building such as this introduces design problems not encountered in new construction. Service to all tenants must be maintained during working hours. Temporary and permanent work requiring premium time must be kept at a minimum and all obstacles must be removed or avoided.

A complete study of all conditions was made prior to determining the most economical and efficient system of electrical distribution. The preliminary investigation, using the most heavily loaded section as a guide, in comparison with present-day practice of illumination level, determined the amount of energy that would be needed in other parts with similar occupancies. In addition to that required for overhead lighting, account was taken of the needs of plug-receptacle-fed devices such as office machines, fans and desk lamps, as well as window air conditioners.

Considering the present maximum use, loads imposed by modern illumination, and energy required for other purposes, the design constants in Table I were found suitable. Using these figures, together with the special loads expected and the floor areas involved, permitted the computation of probable connected loads by floors, Table II.

This gave a total load of 2443 kva and, based on a demand factor of 60%, a maximum projected future demand of 1466 kva. Added to this is 300 kva for building-service power, which gives a total demand load of 1766 kva that can be expected to develop over the next 20 to 30 years. Based on the rate of growth of commercial loads in other buildings, and present maximum

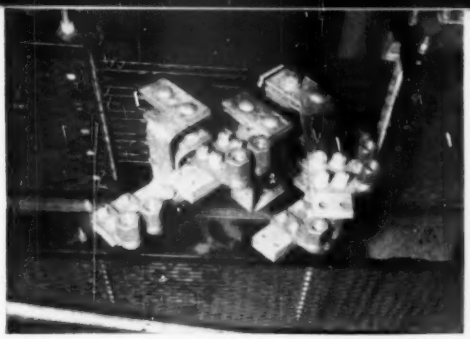


FIG. 2—Interlaced phase bars, except for neutral conductors at top, keep reactive voltage drop to a minimum. Cable lug take-off taps are silver plated for good conductivity.

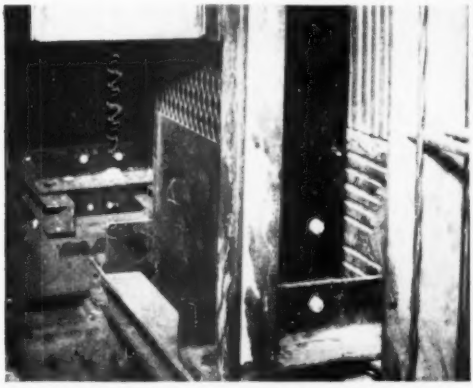


FIG. 3—Busway risers are supported on steel beams and channels through angle irons, held by the busway insulator clamping bolts. Distribution panel (upper left) is an integral part of the busway enclosure at take-off points.

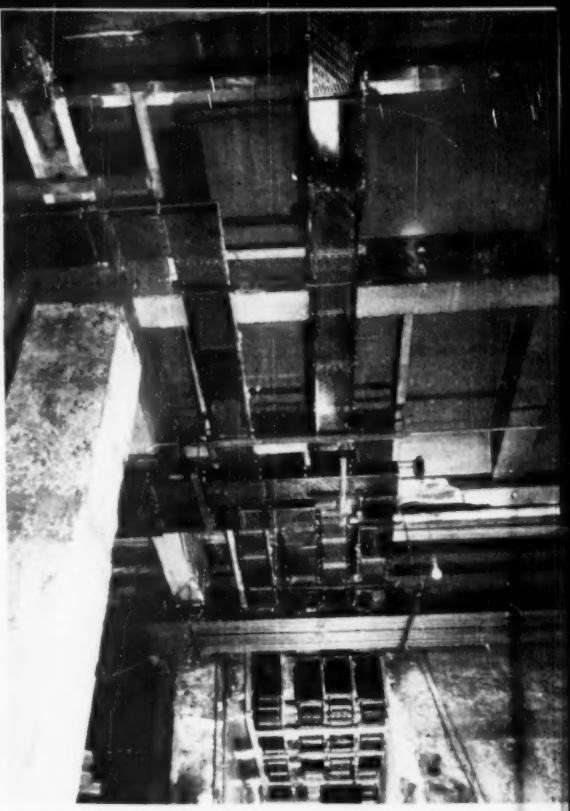


FIG. 4—Busway runs from main service switchgear across basement ceiling to stack shaft (lower center) where it rises to 15th floor and feeds take-off points at every third floor level. Prefabricated sections simplified erection.

loading in some parts of the building, it seemed advisable to install a system of this capacity.

A survey of existing facilities indicated that the ¾-inch conduits running from branch circuit panels to floor bays were the only parts of the present system that could be retained. From this point back to and including the utility company's service equipment, everything would have to be replaced and, as a preliminary, the following standards were set for voltage drop:

Branch circuits (longest 100 ft. unbalanced)	1.16 volts
Risers to floors (full load balanced)	2.00 volts
Service feeders (full capacity of transformer balanced)	0.79 volts
Total voltage drop to neutral	3.95 volts

Final outcome of these studies was to select a single system to supply energy for both light and power. It is the 120/208 volt, 3-phase, 4-wire system in general use in downtown Pittsburgh and other large metropolitan areas. The use of booster

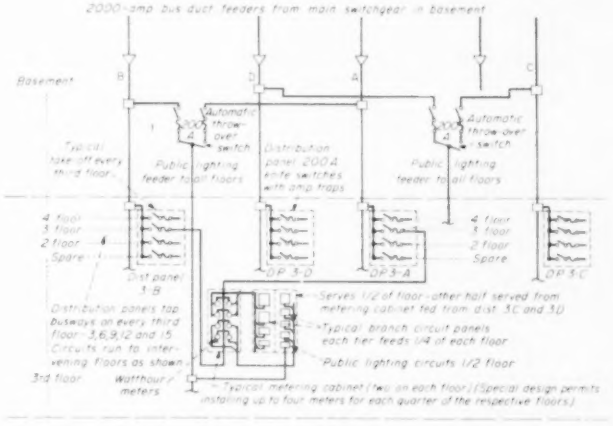

2000-amp bus duct feeders from main switchgear in basement
Basement
B
D
A
C
Automatic throw-over switch
Automatic throw-over switch
Typical take-off every third floor
Public lighting feeder to all floors
Distribution panel 200 A knife switches with amp traps
Public lighting feeder to all floors
4 floor
3 floor
2 floor
Spare
4 floor
3 floor
2 floor
Spare
1st panel 3-B
DP 3-D
DP 3-A
DP 3-C
Distribution panels top busways on every third floor—3, 6, 9, 12 and 15. Circuits run to intervening floors as shown
Serves 1/2 of floor—other half served from metering cabinet fed from dist. 3C and 3D
Typical branch circuit panels each tier feeds 1/4 of each floor
Public lighting circuits 1/2 floor
3rd floor
Watthour meters
Typical metering cabinet (two on each floor) (Special design permits installing up to four meters for each quarter of the respective floors)

FIG. 5—Distribution system one-line diagram showing take-off from two busway feeders including typical metering cabinet and branch-circuit panels which supply one-half of a floor. Similar take-offs on feeders C and D supply other half of each floor.

FIG. 6—Specially fabricated sections having the interlaced phase bars fanned out to match down-coming jumpers.

FIG. 7—Special terminals ahead of meters permit metering from one to four tenants in a one-quarter floor area.

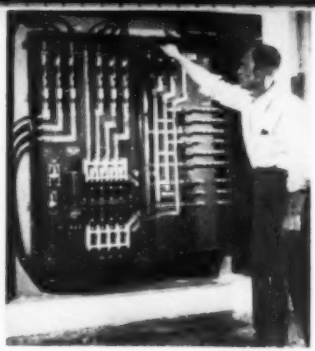


FIG. 8—Two automatic throwover switches serve emergency and public lighting throughout building.

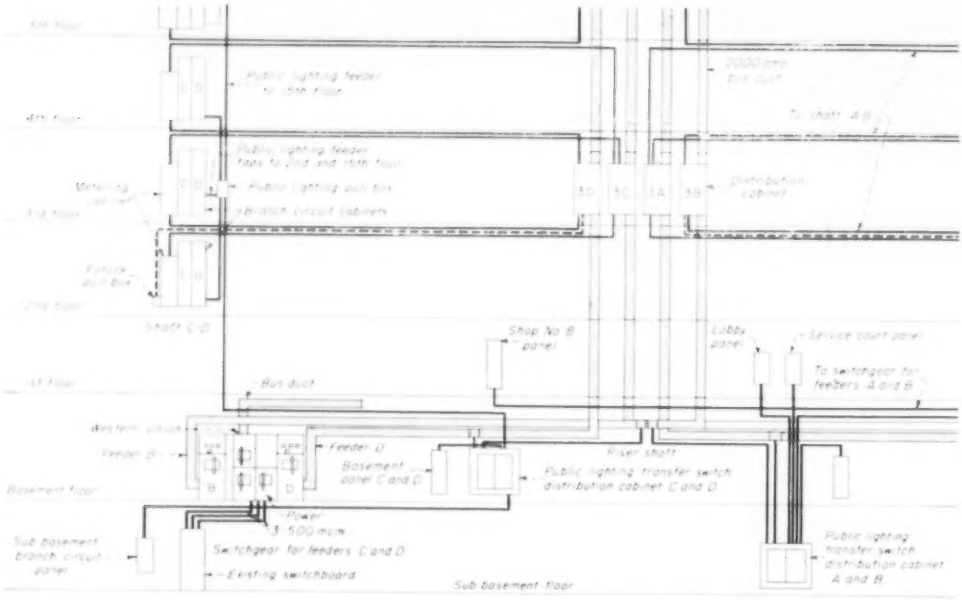

Public lighting feeder to 15th floor
3000 amp bus duct
To shaft A-B
Public lighting feeder taps to 2nd and 15th floor
Public lighting pull box
Branch circuit cabinets
Distribution cabinet
Shaft C-D
Shop No. 8 panel
Lobby panel
Service court panel
To switchgear for feeders A and B
Bus duct
Feeder D
Feeder B
Basement panel C and D
Riser shaft
Public lighting transfer switch distribution cabinet C and D
Power 3-500 mcm
Switchgear for feeders C and D
Existing switchboard
Sub-basement branch circuit panel
Sub-basement floor
Public lighting transfer switch distribution cabinet A and B

FIG. 10—Taps on busway risers feed individual distribution panels containing four 200-amp. knife switches at every third floor level. Three switches connect to cable sub-feeders supplying lighting metering cabinets, fourth will be used for power load.

transformers to serve the elevator motor-generator sets and other building-service power equipment presently wired for 230 volts was considered. Recorded temperature-load tests, which were run on both the old and new voltage and then compared, indicated that boosters are not required.

The next step involved a complete structural survey of the building to determine the space available for the various feeders and sub-feeder conduits preliminary to actual selection of equipment. Physical measurements and levels had to be made and runs plotted to find paths through machinery and piping areas that would minimize the amount of preparation work needed. The most congested area was across the basement ceiling through a maze of piping, Fig. 1, but a detailed study of the obstructions and the use of the simple water hose level disclosed clear paths with the exception of a short run of sewer pipe, which had to be offset.

Fortunately the building contained an abandoned boiler-stack shaft, but even with this break, the space available was limited and was a major factor in determining the type of distribution system selected. Much space is required for a wire and conduit system for the many conduits and junction boxes that would be needed, not to mention the cable supports required for the shaft risers, and the number of bends and threaded connections involved. Another factor of paramount importance was flexibility for future extensions. How many future needs could be provided on the present program to keep the present as well as future installations safely within an economic range and have desirable simplicity?

The best solution for the over-all problem of getting the electrical energy up through the building appeared to be the use of prefabricated busway that would be installed easily and supported in the space available, and that had inherent provisions for take-offs for present and future requirements. With the proposed total connected load of over 7000 amperes on the feeders through the building, and considering

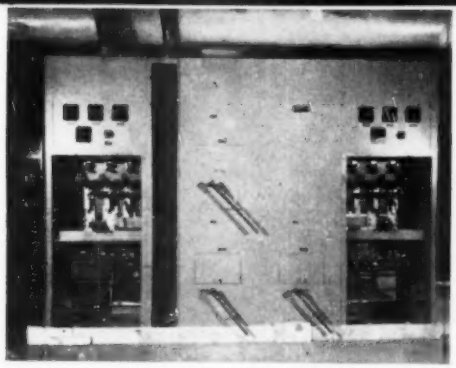


FIG. 9—Busway feeders adjacent each end of switchboard are supplied by Pringle service entrance switches.

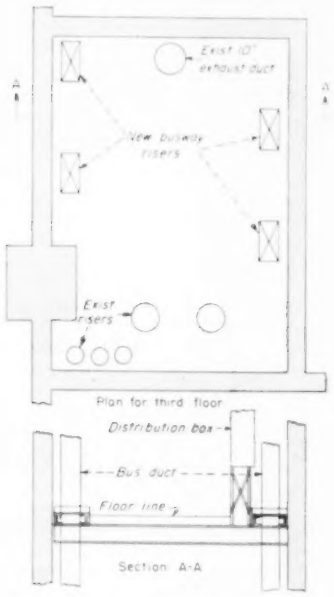


FIG. 11—Busway risers are supported in boiler stack shafts. Two stacks serve the entire building.

TABLE I. Design Floor Loads for Pittsburgh C. of C. Building

Type of Load	Areas: Office Space	Shops	Corridors Stairs	Toilets Closets	Basements
Overhead lights (Watts / sq. ft.)	5	6	2	2	2
Plug receptacles (Watts / sq. ft.)	2	2	—	—	—
Total load	7	8	2	2	2
Air conditioning (Watts / outside bay)	845	—	—	—	—
Window lights (Watts / lineal ft.)	—	200	—	—	—

TABLE II. Present Lighting Demand and Proposed Loads

Area	Present Lighting Demand Loads (watts)	Proposed Connected Load (watts)
16th Floor	———	131,731
15th Floor	7,500	143,491
14th Floor	31,300	143,491
13th Floor	40,000	143,491
12th Floor	70,000	143,491
11th Floor	21,000	143,491
10th Floor	46,500	153,491
9th Floor	28,700	143,491
8th Floor	53,000	143,491
7th Floor	32,400	143,491
6th Floor	42,600	139,076
5th Floor	42,200	137,576
4th Floor	37,000	137,576
3rd Floor	30,200	137,576
2nd Floor	21,200	138,359
1st Floor	46,500	154,942
Basement	9,800	41,328
Total	**560,700**	**2,319,583**
Special Loads		123,417
Connected Load on Lighting System		**2,443,000**
Demand Load on Lighting System (60% Demand Factor)		1,465,800
Demand Load on Power System		300,000
Total Demand Load for Building		**1,765,800**

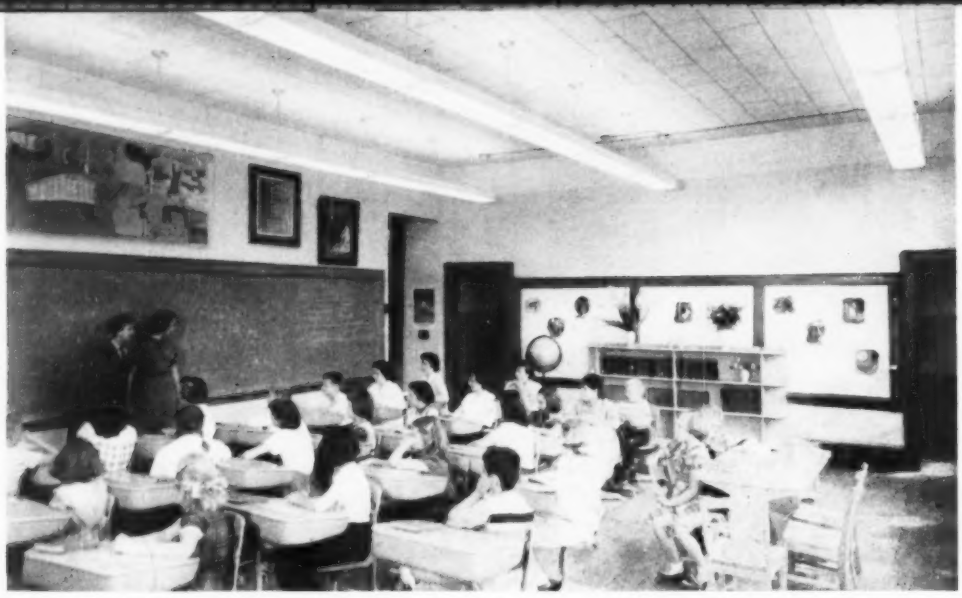
both load diversity and voltage drop, the best design appeared to be four 2000 ampere feeders. Final selection was the Lo-Loss busway manufactured by the National Electrical Products Corporation, because it met the essential requirements, and from experience was known to be satisfactory in service. It consists of ¼ x 2-in. individually insulated copper bars closely spaced with phase bars interlaced, Fig. 2, to keep reactive voltage drop to a minimum.

Bus section joints are silver plated for best conductivity and the 20-in. spacing of insulators enables the busway to withstand short circuit stresses above 75,000 rms amperes, which is theoretically available on the load side of the service switches connected to the utility low-voltage network. Each phase consists of four bars up to the 9th floor, and three beyond with two for the neutral conductor.

Busway enclosure is of the ventilated type except where it passes through basement walls, floors and firestops in the riser shaft. At these points the housing is solid for 10 inches on each side of walls and above floors. The National Electrical Code specifies 6 feet, but special approval was secured from local inspector because the riser shaft is not accessible to the public. Firestops in the enclosure match those at floors. Channel iron and I-beam supports for the vertical risers span the stack shaft at each floor level. Angle-iron feet, bolted to the busway enclosure, rest on the channel-iron members, Fig. 3. Horizontal runs across the basement ceiling are carried by hangers welded to the building steel every five feet. They average not more than 30 inches from the center of a joint or more than 20 inches from a change in direction. The busway was prefabricated in sections at the factory and each section identified on an installation drawing, which simplified erection and lining up, Fig. 4. A small motor-driven winch and snatch block hoisted all sections to the ceiling and up the shaft.

Figure 5 shows the general arrangement of the electrical system which

(*Continued on page 177*)

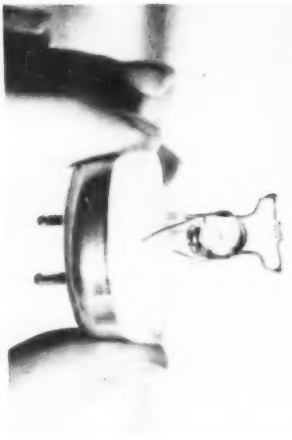


THIS CLASSROOM in the Lincoln School, Wauwatosa, Wisconsin is lighted to 45 footcandles intensity. It is one of 43 classrooms so lighted in a city-wide relighting program, first major installation of a new fluorescent lamp and ballast development . . .

. . . Rapid-Start Fluorescent Lighting

Wisconsin Schools adopt new type fluorescent lamps and ballasts for relighting to provide greater economy, quieter operation, and simplified maintenance in their lighting systems.

By C. J. Allen *School Lighting Specialist, General Electric Company Nela Park, Cleveland, Ohio*



TRIPLE-COIL CATHODE of new Rapid-Start lamp permits fast initial heating. This new coil securely holds more electron emitting material for long sustained lamp performance.

WHEN the children of two Wauwatosa, Wisconsin schools returned to their classrooms this fall they were greeted with something new in lighting. The something new was that the fluorescent lamps came on smoothly and in unison with barely a second's delay after the switch was turned on. Gone was the winking and blinking which most individuals had come to associate with the starting of fluorescent lighting.

The classrooms of these two Wauwatosa schools are believed to be the first major installations of the new Rapid-Start fluorescent lamp and ballast circuit. This new method of operating 4-foot 40-watt lamps gives rapid starting without starters and provides economy equivalent to preheat starter type operation.

An added feature of the new Rapid-Start ballast is that it is among the quietest of the various types of ballasts.

ANSWERS TO SOME TYPICAL QUESTIONS ON RAPID-START OPERATION

Q. *Is the Rapid-Start lamp a special lamp or can the preheat or instant-start lamp be used on the new Rapid-Start ballast?*

A. *The lamp is of special design and other lamps should not be used on the new ballast. The cathodes in the new lamp are triple-coil construction designed for fast initial heating by special windings in the ballast. The cathodes in the preheat lamp would not be properly preheated and the cathodes in the instant-start lamp could not be heated at all by the ballast because they are shorted-out inside.*

Q. *What is the life of the Rapid-Start lamp?*

A. *It is 7500 hours when operated 3 hours per start.*

Q. *Can existing preheat type fluorescent fixtures be rewired to take the Rapid-Start lamps and ballasts?*

A. *They can, if it is desired. The former ballast would be replaced by the Rapid-Start ballast and the wiring to the lamp holders changed, eliminating the starter circuit. The Rapid-Start ballast is in the same size "A" case and is approximately the same weight as the 120-volt preheat-start ballast for two 40-watt lamps.*

Q. *Will Rapid-Start lamps supplant preheat lamps?*

A. *It is expected that they will for new installations using 4-foot luminaires.*

This feature is particularly important in classrooms and offices and especially in areas where quietness is specifically desired.

The starting features of Rapid-Start fluorescent lighting is appreciated by the occupants of rooms using this new system, and also by the building custodian—but in another way. If a lamp in a preheat type luminaire fails to start the custodian is called. Unfortunately, he is sometimes non-plussed as to what is wrong. Is it the lamp, is it the starter, or is it the ballast that is causing the trouble? The custodian has three electrical components he can check. Elimination of one of these components would be a step toward simplified maintenance. The Rapid-Start circuit accomplishes this by eliminating the starter, and thus should make the custodian's life just a bit happier. Where the 8-foot instant-start slimline lamps are used, they also have this advantage.

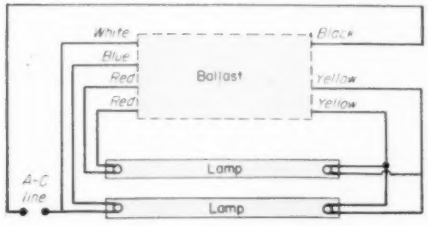
The Wauwatosa school system has shown a progressive history in its program of improving the visual environment for their students. In 1942, they started their improvement by instituting a painting program of lighter colors and finishes for making use of the light which they did have. In 1946, the assistant superintendent of schools realized that better lighting was needed in the classrooms and began active planning for a relighting program. After checking the various aspects of classroom lighting, he equipped five classrooms in a high school building with three rows of two-lamp 40-watt fluorescent luminaires in each. Luminaires from a different manufacturer were installed in each of the five rooms. The shielding specified for the luminaires was 35° crosswise and 45° lengthwise, although there were few luminaires at that time which met these specifications.

Several building additions were constructed in Wauwatosa schools beginning in 1947 and specifications for each included a 45 footcandle level of illumination to be provided by the three-row fluorescent installation. Upon completion of the pattern for relighting the schools in 1949, the services of a school lighting consultant were recommended to survey the buildings and make specific recommendations for the implementation of the program. Professor R. C. Putnam of Case Institute of Technology was retained for the purpose. His recommendation included the use of preheat fluorescent lamps for this initial relighting. Instant-start lamps were also considered, but the economies that then existed favored the preheat lamps. The recommendations were for the three continuous rows of F40T12 two-lamp luminaires, providing for about 45 footcandles maintained.

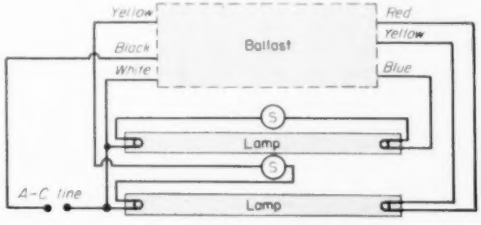
Because of budgetary considerations, Professor Putnam recommended that all critical seeing task rooms be relighted as the first step in the program. The Board of Education and the superintendent of schools and his assistant concurred in his recommendations. Immediate attention was then given to putting the recommendations into operation and all critical seeing task rooms and one high school building were relighted.

The years of 1950 to 1952 showed considerable progress in better lighting equipment being made available by the fixture manufacturers. By this time

(Continued on page 179)



(a) Rapid-start circuit



(b) Preheat-start circuit

WIRING an Integrated Community

Establishing mass-fabrication shops and portable communication facilities, providing numerous power tools and carefully pre-planning all operations solved problems involving mass procurement and delivery of equipment, field assembly of components and contact between supervisory personnel at San Francisco's impressive new community development at Parkmerced*.

By Charles A. Langlais
Electrical Contractor, San Francisco, Cal.

OVERLOOKING LAKE MERCED and the Pacific Ocean, this Metropolitan Life Insurance Company's 200-acre

**PARKMERCED is an impressive, completely planned and integrated city-within-a-city on the outskirts of San Francisco, conceived and built by the Metropolitan Life Insurance Company to express the finest concepts of apartment residence. Including 3483 separate apartments variously grouped in 13-floor tower units, duplex "garden" apartments and picturesque 2-story buildings, this outstanding 200-acre project also incorporates three multi-story garages, administrative and maintenance centers and a comprehensive shopping hub. Each apartment has a separate meter, service breaker and multi-circuit fused panel. Mercury switches provide quiet operation of lights and appliances. Fully automatic pushbutton elevators provide fast, smooth vertical transportation.*

Exterior illumination is furnished by ornamental fixtures controlled by astronomical clock mechanisms. Tenant cars are cared for in garages equipped with electric grease racks, loud speaker relays for car paging, forced ventilation and high-intensity fluorescent lighting. Optimum-quality AM, FM and TV reception is fostered through the installation of master antenna systems. The completed project reflects sound management, competent supervision and skilled workmanship using high grade tools and equipment.

This community development is a tribute to the cooperative efforts of electrical contractor Charles A. Langlais, engineering consultant Thomas B. Hunter, general contractors Starrett Brothers and Eken, and architects Leonard Schultze and Associates, Harry A. Thomsen and Aleck L. Wilson.

THE development of Parkmerced in suburban San Francisco is impressive in scope, architectural treatments and tenant services. But the true electrical significance of this vast project lies not in size or services but in methods adopted to speed this $12-million electrical contract to completion. Problems of mass procurement and delivery, communication between supervisory personnel, field assembly of components and labor coordination were numerous. Yet these problems were solved expeditiously by an organization backed by three decades of construction experience.

The extensive use of power tools played an important part in both the assembly of materials and the installation of equipment. Such tools included electric saws and pipe threaders, drills and grinders, hammers and compressors, sanders and buffers, welders and winches, spray-painting equipment and an m-g set.

The use of electrical testing equipment was likewise extensive, with such items as clamp-on meters, megohmers,

- A Pacific Ocean
- B Lake Merced
- C Public Golf Course
- D Tower Units
- E Garage
- F Recreation Area: Softball, Horseshoes, Tennis, etc.
- G 1, 2 and 3-bedroom duplex apartments
- H Parkmerced Common
- I 2 floor, 3 bedroom garden apartments
- J Administrative and Executive Offices
- K San Francisco Golf Club
- L Site of Shopping Center: super market, bank, bakery, barber shop, hardware, haberdashery, etc.
- M To Downtown San Francisco

community development on the outskirts of San Francisco includes 3483 apartment units equipped with a wide range of electrical services to provide tenant comfort and convenience.

sound power phones and industrial circuit testers included on the instrument inventory.

On a project of this size it was also necessary to have a variety of mobile services, ranging from heavy-duty boom trucks to jeep-mounted ditching machines. Delivery of material from field assembly depots and stock bins to the various building sites was by means of pick-up trucks and trailers. Trailers also were employed as field offices, which were connected to the project's main engineering office, the pre-fab shops and the storage areas through temporary telephone lines. With this arrangement it was possible for foremen to check installation details, summon critical materials, direct the work of special crews and correlate the activities of various trades without having to leave their own areas of jurisdiction.

Since duplication of floor plans was widespread, with each typical floor or housing unit calling for identical numbers of conduit sections, ells, outlet boxes, switches, etc., mass production and pre-assembly was the only logical way to handle this huge installation job.

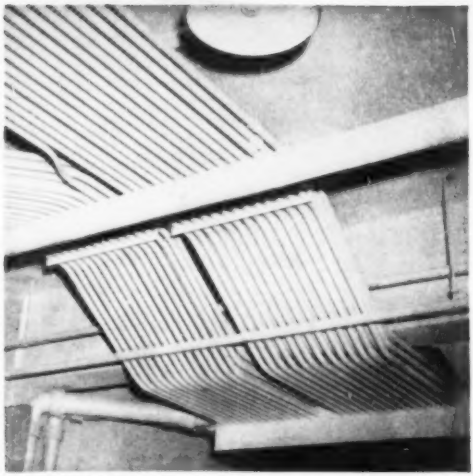
Two field-assembly shops were set up for these production-line operations, with conduit and EMT first racked adjacent to motor-driven metal-cutting hand saws for initial cutting. From these starting points, conduit was progressively threaded by machines equipped for automatic chucking and reaming, bent to specification, then capped by paper discs and bushings so that debris would not enter sections prior to installation. These paper discs also served as routing indicators, with the intended location of an assembly noted on these sealing caps for reference and delivery purposes. By having duplicate production and requirement schedules of materials conveniently posted adjacent to all cutting, threading and bending points, fabrication errors were minimized and waste through unnecessary duplication was practically eliminated.

The 13-floor tower units receive 4160-volt 4-wire service from PG&E's network, with 3/c 5-kv PL primary cables and an approved neutral entering reinforced-concrete basement-based substation vaults through underground ducts and waterproofed wall entrances. Ducts are asbestos-cement, with joints effected through couplings blanketed by a sealing compound. Anchors were used at close intervals to prevent ducts from "floating" during the pouring of concrete envelopes.

Each vault contains three 4160/120-208-volt 3-phase wye-wye transformers, with secondary cables (three 500-MCM RH conductors per leg whipped with heavy cord) tapped to a 1500-amp 4-wire enclosed busway running to a separately-vaulted dead-enclosure free-standing main switchboard.

The boards, specially designed by Thomas B. Hunter and fabricated by Western Switchboard (a subsidiary of the Electrical Contractor), differ from standard commercial units in that they provide for separate metering of each individual apartment. With a 1600-amp main air circuit breaker, each main board incorporates a convertible

TOWER UNIT SWITCHBOARDS are equipped with 1600-amp main air circuit breakers, distribution sections to control general power and lighting, and spaces for 170 tenant meters, each equipped with terminal type ring sockets, blocks and sealing rings. Parkmerced has 11 boards of this type.



FEEDER CONDUITS for tower units are neatly racked along basement ceiling, extend from each switchboard to eight separate riser points. Risers are cast integrally into each floor slab, anchored therein by means of crossarms welded to conduits and embedded in the concrete.

distribution section for general power and lighting, and six tenant-metering panels having combined facilities for 170 meters.

Convertible distribution panels centralize those feeders running to local control centers in penthouses, corridors, laundries, boiler rooms and basements from which are operated elevator motors, roof fans, compressors, pumps, sewage ejectors, oil burners and lighting for all public and service areas. Motors are variously controlled through pushbutton stations, aquastats, float switches and (for lighting) time clocks with astronomical dials. Combination starters have built-in disconnects.

Tenant meter panels are equipped with terminal type ring sockets complete with terminal blocks and sealing rings.

Radial Feeder System

Feeder conduits to apartments are neatly racked on trapeze supports and are carried along the underside of first floor slabs in radiating groups to eight separate riser points. From there, feeders are carried upwards to the various electric closets, with riser conduits cast into floor slabs and anchored therein by means of short lengths of reinforcing rods welded to the conduits. Mechanical strain on conductors is lessened through the use of wedge-type cable supports, and injury to insulation was precluded by using powdered soapstone to lubricate cables during the pulling-in operation. To readily identify circuits, cables are tagged in all pull boxes and panel gutters. Feeders are generally RH cables insulated for 600 volts and sheathed with Neoprene jackets. Branches are R, RU, or RH, depending upon location and function, and are likewise sheathed with Neoprene except where installed in basement slabs. There the sheathing is lead. All splices are WU type, made mechanically strong prior to soldering and taping.

Although the 116 two-story "garden apartment" units are separately constructed on ground-surface reinforced-concrete slabs, they are connected to one another by a 7-foot-high walk-through tunnel which carries all electric, telephone, gas and water services for owner as well as tenant consumption. Owner-operated facilities include exterior lighting, equipment such as pumps, and incidental heating devices.

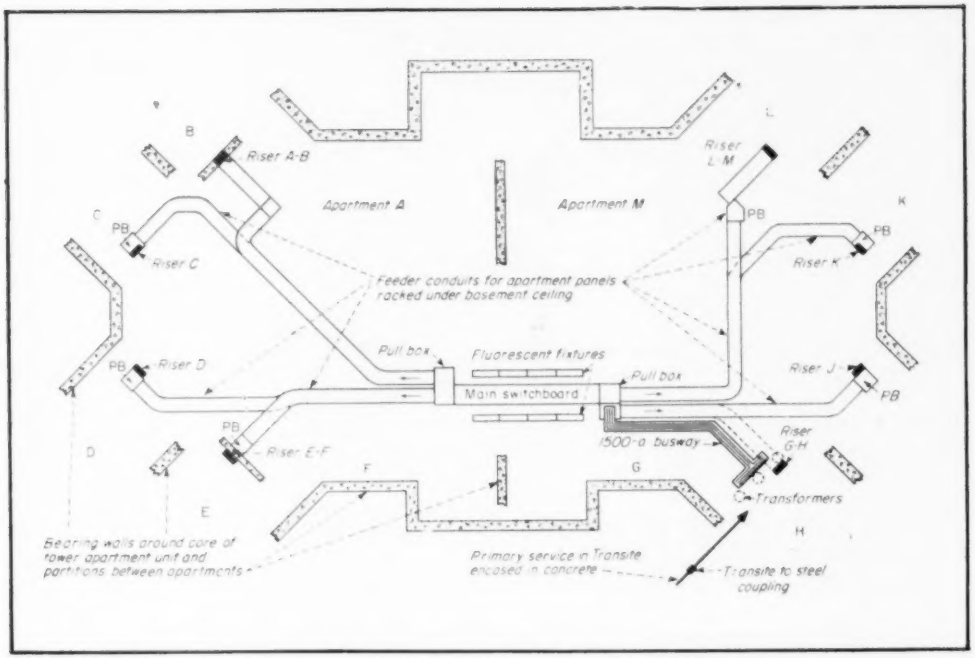
All conduits are supported along tunnel walls and ceilings, with metallic supports, cabinets, gutters and other non-current-carrying electrical equipment securely grounded to copper cables via clamp fittings, and the grounding bonded to the water system.

As branch conduits are carried upwards to switching and utilization points, they are predominantly run concealed in concrete walls, partitions and floor slabs. Exceptions exist only (1) where concrete slabs are less than 3½-inches in thickness and (2) where wood-joist construction is found. In the first case, conduits (except short local offsets) are run exposed. In the second instance, wood joists are notched close to bearing walls so that conduits may be carried within joist space without compromising bending moments of beams.

Special Meter Panels

Utility service to tunnel distribution panels is variously 120/208-volt 3-phase 4-wire and 120/240-volt single-phase 3-wire. Apartment meter panels are provided with individual hinged switch and fuse units in separate steel enclosures, so designed that circuits are disconnected when doors are opened. All switch poles break simultaneously; terminals are provided with solderless lugs, and units may be readily re-fused for less-than-capacity line amperage if so desired. Panelboard cabinets, where mounted on concrete walls, are supported by bolts and lead anchors in drilled holes.

Multiple-story garage No. 4 is electrically served by a special transformer vault supplied by 4160-volt 3-phase 4-wire SN wye feeders installed underground in asbestos-cement duct from the utility manhole to the garage transformer vault. Garages 1 and 2 are supplied by 120/240-volt single-phase current from the main switchboard. Main switchboards are dead-front free-standing units having 1200-amp air circuit



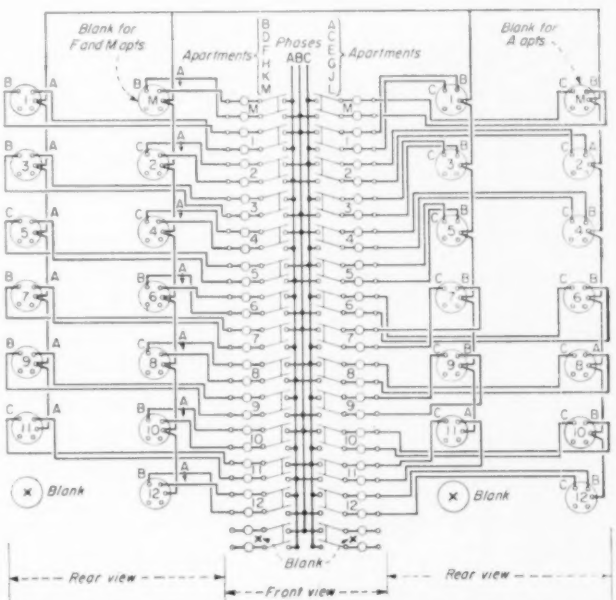
MAIN SWITCHBOARD in basement of tower unit receives power from enclosed busway which connects board to underground-fed 4160/120-208-volt wye-wye transformer bank. Feeder conduits for apartments radiate to riser points, then are carried upwards.

breakers with 1200-amp dual overcurrent trips, pushbutton mechanical trips, and position indicators. Transformers (4160/120-208-volt wye-wye) and main boards are connected through 1500-amp 4-pole enclosed busways. Secondary distribution and control generally follows the pattern discussed in connection with tower apartment structures.

These garage buildings are equipped with complete pedestrian door signal systems having annunciator indicator panels, remote-control relay-operated main entrance and fire doors, loudspeaker paging systems, and pushbutton stations for remote control of lighting. Where lighting fixtures cannot be seen from control points, pilot lights are incorporated with switches in control stations.

Job Coordination

This entire project reflects the high order of effort and coordination that existed during the construction period between electrical contractor, electrical consultant, general contractors, architects and owner. It also shows the results of practical management methods, competent supervision and skilled labor working with the best of tools and equipment available.



TYPICAL CONNECTIONS of a tenant metering panel, six of which are included in each of the eleven tower switchboards. Boards are free-standing, permitting ready access to front and rear panels. High-level illumination is provided by 4-section 2-lamp overhead fluorescent runs mounted above the switchgear.

UNIT SUBSTATIONS, suspended from standard H-section welded trusses, keep floor space entirely clear of obstructions. Service continuity is guaranteed by a secondary loop connecting these load center units, while production flexibility is facilitated through the installation of plug-in bus-ducts above truss levels.

KEY FOR CONVERSION

Three important factors for effective industrialization—service continuity, flexibility and planned lighting—are obtained in a new Westinghouse manufacturing plant through the mediums of dual distribution, secondary loops, plug-in bus-duct. These features facilitated the conversion from television to electronic production.

WHEN Westinghouse manufacturing executives decided on a flexible distribution system for their new $1½ million television-radio plant in Metuchen, New Jersey, they probably did not anticipate that, even before the building had been completed or television production lines installed, plans would have to be modified so that classified electronic equipment could be produced for the armed services. Yet this production shift actually occurred and, had it not been for the extreme flexibility of the basic electrical framework, transition would have been a time-consuming, costly operation. The fact that the shift was made quickly, smoothly and economically attests the wisdom of the preliminary planning.

Designed by The Austin Company and wired by cooperating electrical contractors Fischbach & Moore of New York City and Beach Electric of Orange, N. J., the 10-acre flat-roofed plant combines up-to-the-minute electrical practices with many progressive structural treatments.

One of the first considerations in planning the electrical system was continuity of service and, for this purpose, dual primary and secondary feeders were provided. Direct lines from two separate utility substations enter the plant's main outdoor substation; both supply lines terminating in cross-connected motor-operated transfer switches that automatically shift the load from one power source to the other in the event of a partial utility outage. Normally the plant load is carried by one feeder only, the second line serving as a standby. Service is received at 26.4-kv and is stepped down to a primary distribution level of 4.16-kv at the outdoor substation which includes two outdoor transformers having ratings of 1250-kva under normal operating conditions and 1500 with forced cooling.

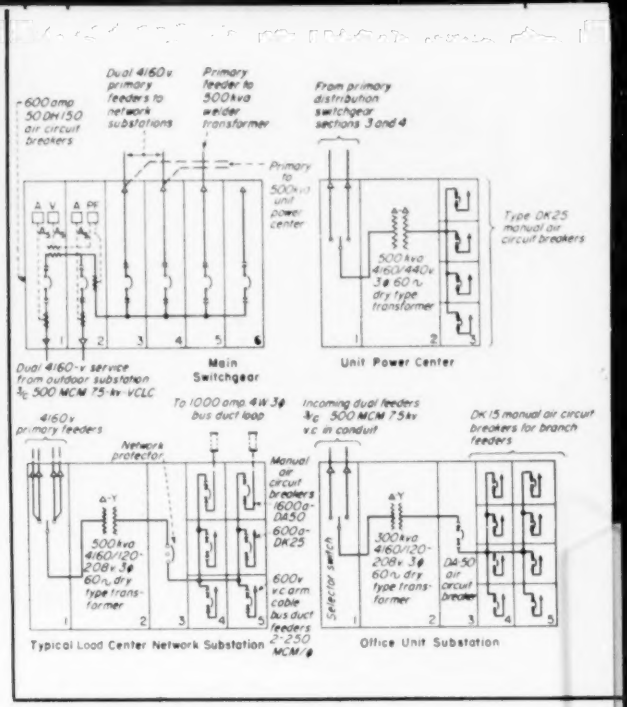
The use of two smaller transformers rather than a large single unit again provides insurance against service interruption, for it permits planned maintenance shut-downs at predetermined intervals. As long as these shut-downs (due to either maintenance or emergency causes) are not prolonged, either transformer can carry the full load and can operate from either incoming utility line.

From this outdoor sub, 4160-volt current is carried via underground conduits to the indoor metal-enclosed primary switching center which includes four feeder breakers with ICs of 150,000-kva. Primary switchgear, as well as the outdoor gear, is operated by a 60-cell storage battery maintained at standard potential by a Rectox charger rated at 115 volts on 60-cycle ac. The battery is a two-step acid-type unit with pasted plate assemblies in sealed glass jars.

Utilization power at 440-volts is obtained through a delta-delta 500-kva 3-phase dry-type transformer, and 120/208-volt current for office and manufacturing areas is secured through four 500- and one 300-kva delta-wye units. All secondary substations are served by two 4160-volt feeders extending from the primary switching center, once again emphasizing the provision for dual distribution as insurance against service interruption.

The four 500-kva 4160/120/208-volt transformers serving the manufacturing area are mounted on platforms suspended from roof trusses, thus removing these load-center substations from the working floor and thereby re-

INDUSTRIAL FLUORESCENT FIXTURES mounted end-to-end on 12-foot centers at a 16-foot elevation provide 50 footcandles of illumination 3 feet above the floor. Control panels are recessed between column flanges.


600 amp 50 DH 150 air circuit breakers
Dual 4160-v primary feeders to network substations
Primary feeder to 500-kva welder transformer
From primary distribution switchgear sections 3 and 4
Primary to 500-kva unit power center
Type DK 25 manual air circuit breakers
500 kva 4160/440-v 3φ 60-∿ dry type transformer
Dual 4160-v service from outdoor substation 3/C 500 MCM 75-kv V.C.L.C.
Main Switchgear
Unit Power Center
4160-v primary feeders
Network protector
To 1000 amp 4-W 3φ bus duct loop
Incoming dual feeders 3/C 500 MCM 75-kv v.c. in conduit
DK 15 manual air circuit breakers for branch feeders
Manual air circuit breakers 1600a-DA 50
600a-DK 25
600-v v.c. arm cable bus duct feeders 2-250 MCM/φ
500-kva 4160/120-208-v 3φ 60-∿ dry type transformer
300-kva 4160/120-208-v 3φ 60-∿ dry type transformer
Selector switch
DA 50 air circuit breaker
Typical Load Center Network Substation
Office Unit Substation

SWITCHGEAR for 4160-, 440-, 208- and 120-volt control consists of metal-enclosed cubicles containing breakers, network protectors, bus-tie connections, instrument panels and transformation sections. Dual distribution serves all units.

leasing the floor area for industrial applications. Once again, service continuity influenced design, for these four substations are connected through a secondary loop and, should one of the four units fail, power throughout the plant would be maintained by the remaining three units.

All breakers operate on the De-ion arc-interruption principle and each substation includes a network protection section capable of carrying 1400-amps continuously in an ambient temperature of 40-degrees C without overheating. Protectors are rated at 208 volts for ICs of 50,000 amps. Protectors can be closed only when true polyphase power is flowing from transformers to the distribution network, and they automatically open should reverse power flow from the net back toward the transformers. Protectors operate through master, phasing and/or desensitizing network relays.

Distribution of power through the plant is via 1000-amp feeder ducts and 600-amp plug-in bus-ducts mounted above lower truss chords. Approximately 1080 feet of feeder duct and 2110 feet of plug-in duct are used for this purpose.

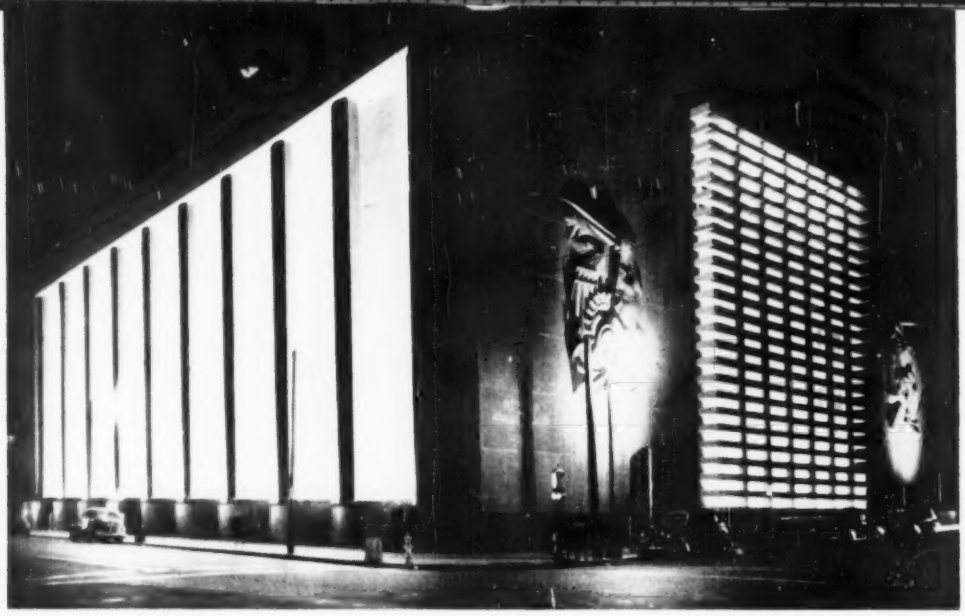
Underfloor multi-duct runs carry 120/208-volt, also low potential circuits for telephone service, throughout the office section. Outlets are on 24-inch centers and all plug receptacles are equipped with two current-carrying and one grounding contact. Grounding contacts are electrically connected to plug yokes and plug-in receptacle slots are so positioned that either grounded devices (such as portable tools) or ungrounded applicances (such as fans) can be connected to the same outlets.

Over 3000 2-lamp fluorescent fixtures are mounted in the building, controlled in groups of seven from narrow column-type control panels mounted between H-column flanges. Between panels and truss-mounted pull-boxes, plates enclose column web spaces to provide continuous wiring gutters. Lamps are 3500-degree Kelvin, operating with no-blink starters and high PF ballast. Intensities exceed 50 footcandles.

Structurally, the plant provides for stright-line production and assembly through 60-foot bays which extend the length of the 1000-foot building. Enclosed railroad spurs and truck receiving and shipping docks are located just inside the walls at either end, making it possible for raw materials to enter the plant at one end, proceed through the plant by direct routes, then emerge as finished products at the other end. In this process materials are variously transported by power-driven roller conveyors, an extensive overhead monorail system, and by battery-operated high stacking fork lift trucks.

Two fire-walls, extending the full length of the building, divide it into three separate zones, while a cinder block rear wall (which could be readily dismantled) provides for future expansion. In addition to fire-walls, safety is promoted through an automatic sprinkler installation and by curtains of corrugated asbestos which have been installed at 200-foot intervals in the roof trusses constructed from welded H-members.

Like the load-center sub-stations, two basic air-conditioning centers are mounted on platforms above the working area, with blowers, filters, heating and cooling coils concentrated here for maintenance ease. Unit heaters are provided for storage areas; office space is heated by conventional radiation.



LIGHT AND ARCHITECTURE are adroitly blended in a most pleasing exterior building design, using special hot cathode fluorescent lamps operated on special circuits for cove lighting plus floodlighting for grille work and ornaments.

MONUMENTAL LIGHTING Identifies Building

Pacific Gas & Electric Company combines light and architectural design for artistic appearance and identification of their Mission Substation in San Francisco.

By Berlon C. Cooper

LIGHT has been used most effectively in combination with structural details to create an unusual and striking exterior architectural treatment for one of San Francisco's modern new buildings. This building is the Mission Substation of the Pacific Gas & Electric Company, and the lighting serves a double purpose. It is a symbol for PG&E's product, electricity, and it identifies and beautifies what might otherwise be a drab and commonplace industrial structure. It is an outstanding example of what can be done by combining light and architecture to achieve a unique and artistic design effect, which is attractive by day and even more effective by night.

Studies and experimental work on the outdoor lighting design for the Mission Substation building were begun in 1948 by PG&E's engineering department personnel, in cooperation with William Merchant of San Francisco, consulting architect for the building. This project comprised three separate lighting problems:

1) Select light sources and locations for same to provide suitable lighting for recessed vertical coves in the exterior side walls of the building.

2) Select light sources and locations for same to provide effective silhouette for grille work on one face (8th Street end) of building.

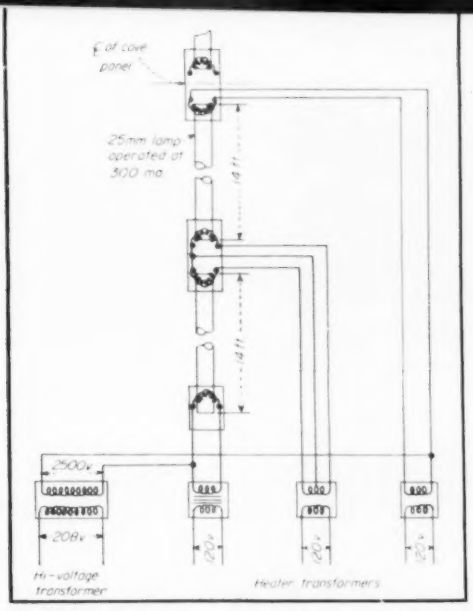
3) Provide suitable floodlighting for cast concrete bas-reliefs on one face (8th Street end) of building.

The building is 150 feet wide, 224 feet long, and approximately 60 feet high. The exterior building surfaces of cast Mo-sai concrete in green-black color, except for the back walls of the coves and the bars of the grille, which are buff color.

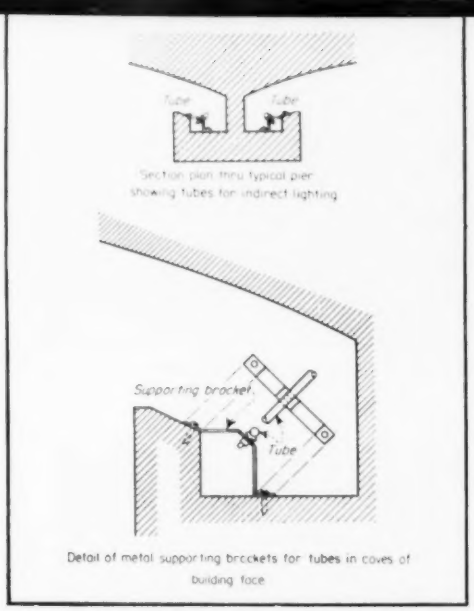
Cove Lighting

Original studies were made with the thought that side lighting of the coves should be of uniform intensity, and that this condition could be produced with fluorescent lamps installed in paracyl reflectors. However, experimental units combining these features produced the illusion of changing the back concave surfaces of the coves to convex surfaces.

Subsequent tests indicated that bare fluorescent tubes installed without reflectors, if placed so as to produce a brightness ratio of approximately 3-to-1 between the edges of the coves and the centers thereof, would result



SPECIAL CIRCUIT operates special 14-foot hot cathode lamps, two in series on 2500-volt secondary.



Detail of metal supporting brackets for tubes in coves of building face

BARE FLUORESCENT TUBES are used to light cove panels indirectly and are supported on simple metal brackets.

in the desired effect. In order to accomplish this condition, it was found to be necessary to increase the power input to the lamps, which in turn would increase the operating costs. However, the elimination of reflectors reduced fixed charges for the initial installation, including interest, amortization and maintenance costs for the reflectors, which more than offset the increase for operation at the larger power load.

The ultimate decision was to use bare fluorescent lamp tubes in the side coves, supplemented by incandescent concentrated beam floodlights at the base of each cove panel to produce "punch" lighting—to feature the height of each 60-foot cove. The installation was so designed that all light sources and equipment are completely concealed from view.

The fluorescent lamps selected for cove lighting are hot cathode fluorescent types, custom designed for the job. Eight 14-foot long tubes are used to light each cove panel, four lamps to each side of the panel. These lamps are 25 mm. Zeon Nonex tubing, operated at 300 ma. to produce approximately 800 lumens per foot. Color of the light produced is warm white to bring out the natural color of the back (visible) surfaces of the coves.

In order to operate these fluorescent lamps at the proper current density required to produce 800 lumens per foot, a special fluorescent two-lamp hot cathode circuit was used. It consists of a 208-volt primary, 2500-volt secondary high voltage transformer, and three 120-volt primary cathode-heating transformers, for each two 14-foot lamps, with the two lamps operated in series. A bank of these four transformers was installed at the top, and a similar bank at the bottom, of each cove. Thermal time delay equipment is used to allow for cathode filament heating before high voltage is applied to the lamps.

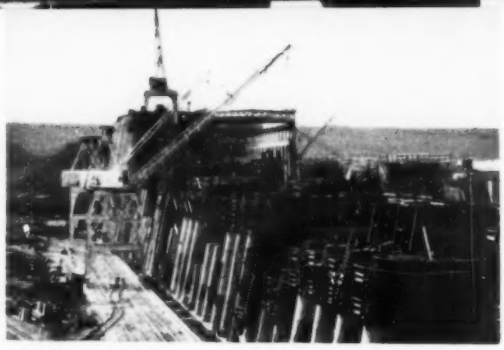
There are a total of 17 coves in the installation, requiring 1904 lineal feet of tubing. Power input total for the high voltage transformers is 255 kva at 98% power factor and the power input total for the filament transformers is 12.2 kva, no power factor correction being provided for the filament transformers because of the low power consumption. The Zeon Nonex lamps were manufactured and supplied by Electrical Products Corp., San Francisco, and the transformers were made by the Electro-Mechanical Engineering Co., Emeryville, Cal.

Four 1000-watt Type ADE-14 enclosed weatherproof floodlights, each equipped with a clear glass cover lens which was lightly sandblasted on the inside surface to give proper diffusion, were used at the base of each of the 17 cove panels to provide the "punch" lighting. These floodlights are equipped with standard PS-40 500 watt lamps.

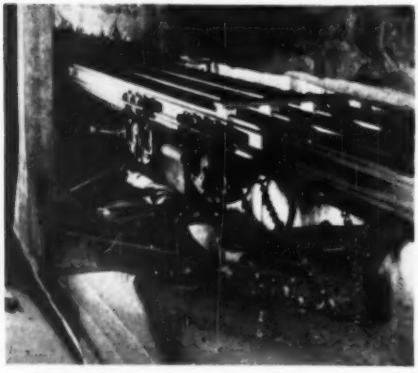
The desired effect for lighting the grille on the 8th Street end of the building, which extends from the top of the building to from four to five feet above the sidewalk, was to silhouette the grille against a lighted background. Experimental studies indicated that use of floodlights installed both at the top and bottom of the space back of the grille, the grille being 5 feet 6 inches out from the building wall, would accomplish this objective. Thus seven concentrating type Type ADE-14 floodlights, each equipped with 300-watt PS-30 lamps spaced equally along the back face of the grille at the top, and seven concentrating type Type ADE-16 floodlights, each equipped with 500-watt PS-40 standard lamps similarly spaced at the bottom of the grille, were used to light the building face and silhouette the grille. This area is concrete, painted buff color, and provides a satisfactory diffuse reflecting surface for this purpose. Floodlight lenses are etched inside to provide the proper diffusion. All floodlights used were Crouse-Hinds.

The lighting effects desired by the architect and PG&E engineers have been satisfactorily achieved in this installation. It represents an outstanding example of modern outdoor monumental lighting using modern light sources and modern concepts of architectural design. It also proves that light and architecture can be combined and used both intelligently and effectively.

EXTENSION ARM from leg of crane structure moves trolleys along recessed run (dark slot).



MOVING CRANES are powered from a track-trolley mobile distribution system, with feeders up right leg of crane.



TRACK-TROLLEY assembly consists of tracks, insulated conductors underneath and trolleys chain towed by L-arm from crane leg.

Outdoor Mobile POWER

How a special track-trolley system for powering moving cranes was developed to assure safe, reliable, low-maintenance operation in the face of severe climatic conditions on the construction of McNary Dam, Oregon.

A MOBILE, safety electrification system for large, concrete-pouring cranes was custom-designed to meet severe climatic conditions at the construction site of McNary Dam, Umatilla, Oregon. Collaborating in the design and development of the system were the Guy F. Atkinson Company, contractors on the job and the Benlow Mfg. Company, Burlingame, Calif., mobile power specialists.

Prior to the installation of the new system, the moving cranes on this job were powered from an exposed, non-insulated rail similar to the third rail of railway trolley systems. This rail was located in a recess along the underside of one of the tracks on which the crane structures moved. With this system, the power takeoff was a flat hinged piece of steel.

This old power system was unsatisfactory for a number of reasons. The exposed rail in the system presented the serious hazard of electrical shock to the many workmen in the immediate vicinity, and was constantly liable to electrical faults due to conducting materials which might touch the rail. But the outstanding objection to this system was its inability to withstand dust storms, extremes of temperature and exposure to the dust, dirt and moist atmosphere present on the project.

In search of a solution, the Atkinson Company requested Benlow to devise a mobile power system which would be safe, suitable for all year outdoor duty, and capable of operating without breakdown under the adverse conditions which prevailed. To the special operating requirements on this job, a 500 ampere track-trolley mobile distribution system was designed. This system consisted of three conductor-bar lengths supported along the recess used for the old "third rail" run and collector shoes sliding along the conductors. Each of the conductors was enclosed in an insulating jacket which was open on its underside only wide enough to accept the collector shoe and allow contact between the shoe and the conductor. The shoes were mounted in trolleys which rode on tracks on top of the insulated conductors. Movement of the trolleys was effected by towing chains which were fastened to the trolleys from an L-shaped arm reaching down from the crane leg.

After installation of the system, its development was primarily concerned with the collectors. Due to abrasive deposits on the conductors and trolley assemblies as a result of dust storms, collector shoe wear was excessive, and the maintenance cost of frequent replacement was high. Contributing to the unfavorable situation was the initial collector design, which did not afford easy change of contact shoes.

After several trial models had been tested in operation, Atkinson engineers evolved a single massive contact shoe that solved the problem. Offering extremely long contact shoe wear, an average replacement of once every three months, the new shoe also had a very simple change mechanism which enabled a shoe to be changed in the field in a matter of minutes.

As it was finally developed, this new electrification system eliminated all of the objections to the old set-up.

Common Code Problems

- **Effect of unequal length of multiple conductors**
- **Isolation of filling station areas**

are discussed by code experts B. Z. Segall and B. A. McDonald

Conductors in Multiple

QUESTION: Section 3105 requires, among other things, that conductors "run in multiple shall be arranged and terminated at both ends in such a manner as to insure equal division of the total current between all conductors that are involved." Does this require all conductors to be of equal length? R. M.

ANSWER: Yes.

To illustrate the effect of unequal length, assume the conditions shown in the following diagram. It will be assumed that the terminations are made to insure proper current division, and that the additional length of cable in one of the parallel conductors is the only factor affecting this current division.

The total current capability of this multiple conductor, assuming the feeder to be installed as open wiring on insulators, is 2×620 (Column 3, Table 2) or 1240 amperes. Use this value for the total current I. The resistance of the 500 MCM conductor is .0216 ohms per thousand feet (Column 7, Table 18). This value is the dc resistance for bare conductors, but actual values are not too important since the final calculations are based more or less on ratios or relative values.

Since these are paralleled conductors, the voltage drops will be equal in both, therefore, $I_1R_1 = I_2R_2$. Furthermore the voltage drop will also be equal to the combined resistance of the two conductors multipled by the total current, or IR.

The total resistance is found by the fundamental formula

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots\cdots \frac{1}{R_n}$$

So for this case

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{R_1 + R_2}{R_1 R_2}$$

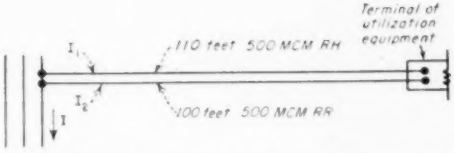
or $$R = \frac{R_1 R_2}{R_1 + R_2}$$

Combining the above equations we may state

$$I_1 R_1 = IR = \frac{IR_1 R_2}{R_1 + R_2}$$

or $$I_1 = \frac{IR_1 R_2}{R_1 (R_1 + R_2)} = \frac{IR_2}{(R_1 + R_2)}$$

Similarly $$I_2 = \frac{IR_1}{R_1 + R_2}$$



UNBALANCED currents in multiple conductors (see text)

It will be noted that R_1 will be 10% higher than R_2 since there is 110 feet of 500 MCM in this line and only 100 feet in the second line. Therefore, it is not necessary to use the actual values of resistance, and our calculations can be simplified by using relative values of resistance, thusly,

$$R_1 = 1.1\,R_2$$

Therefore, $$I_1 = \frac{IR_2}{1.1R_2 + R_2} = \frac{I}{2.1}\,I$$

$$= 1240 \times 1/2.1 = 590.5 \text{ amperes}$$

$$I_2 = \frac{II.1R_2}{1.1R_2 + R_2} = \frac{1.1}{2.1}\,I$$

$$= 1240 \times 1.1/2.1 = 649.5 \text{ amperes}$$

and $I = I_1 + I_2 = 590.5 + 649.5 = 1240.0$ amperes.

I_2 however is larger than the rated current of the conductor by

649.5 − 620 or 29.5 amperes.

The total load, therefore, would be reduced by

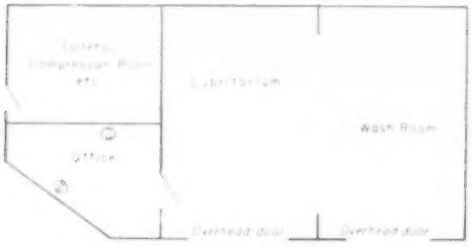
2×29.5 or 59.0 amperes, or

approximately 5%, to keep from overloading one of the conductors.—B.Z.S.

Garage Cutoff

QUESTION: In a gasoline filling station, plug receptacles are located in an office adjacent to a "lubritorium." Section 5141, paragraph b states "Offices, salesrooms, compressor rooms and other similar areas which are suitably cut off from the lubritorium, service and repair room shall be wired to comply with the provision of Article 300." Does an ordinary door which may stand open or even be removed constitute "suitably cut off" in the meaning of 5141 b? H. G. H.

ANSWER: The entire matter depends upon the interpretation of the term "suitably cut off" and since the Code does not clarify this term and your Building Code does not cover the matter, the Inspector must use his



TYPICAL filling station layout showing access door to lubritorium from office (see text)

own judgment with consideration of conditions on the job. I believe, however, that the Code, by inference, gives us an idea of the intent of the term as evidenced in the following rules:

The definition of a Garage, as per the present Code, covers all portions of a building which are not separated by "suitable cut offs." Before 1946 the Code defined a Garage, in general, as all portions of a building which are not separated therefrom by tight unpierced fire-walls and floors. It therefore follows, when this change was made, that the Code discounted to a considerable degree the possible hazards which could occur in rooms or parts of a building adjacent to the Garage occupancy.

In support of this personal opinion, Section 5103-A recognizes a "suitable cut off" for a show room or switchboard room consisting of a reasonably tight partition up to the 4' level. This gives us some idea of the intent of the Code concerning the term "cut off." As you state, Section 5141-b also uses the term with no further clarification. I might add, however, that when the new rules for garages was presented in 1946, the Chairman of Article 510 of the Electrical Committee NFPA made the following comment: "The r sions do not cover in detail methods of building construction as this is a suitable text for a Building Code rather than an electrical Code. Areas cut off by means suitable to the authority enforcing the various codes are considered as outside the scope of the special hazard rules."

In view of the foregoing background, it appears to me that if the Garage is cut off from the Lubritorium by a tight partition and a tight fitting door of the *self-closing type*, the intent of the Code would be satisfied. If the partition has no door then the room would not be cut off. If the partition has a door you might also require a sign advising that the door must be kept closed at all times and the owner should be notified accordingly. Perhaps it is not convenient to operate in this manner and if such is the case, the room would not be properly cut off. All of these questions should be considered in making the decision.

The idea of recognizing a self closing door in a cut off wall is influenced by a similar recognition for the handling of Flammable Liquids as covered by the National Board of Fire Underwriters Pamphlet No. 30. The hazards involved with most of these applications are far greater than that presented by a Lubritorium, yet the principal of a self-closing door in the cut off wall is recognized. I do believe, however, that it should be understood by all parties concerned that the door must be kept closed except when in use. B. A. McD.

Trailers Take Over

Goldberg & O'Brien in Chicago use trailers as a combination field shop and office; gain a big advertising plus.

FIELD OFFICE TRAILER commands attention of passers-by at a plant construction site. Note detachable 3-wire electric service mast at rear.

THE old job shanty with its pot-belly stove is gradually becoming a thing of the past. To keep pace with modern construction techniques, the electrical contractor's equipment must be mobile and have a high salvage value. Management at Goldberg & O'Brien Electric Company, Chicago, applied this philosophy to the problem of field offices and came up with the idea of using trailers—the 28-foot semi-trailer type units plying the nation's highways with cargo shipments.

With the trailer idea came other possibilities of saving time and money on electrical construction projects. The unit could be used repeatedly as a combination field shop and office. It could be loaded to legal limits with an initial shipment of materials to the job site. It could be used effectively to advertise the name of Goldberg &

WELL-EQUIPPED INTERIOR has storage facilities on left, work area on right, office area up front; is well lighted and electrically heated; has direct-line telephone to home office.

SERVICE MAST RECEPTACLE is a 60-amp, 4-wire, grounded, weatherproof type.

O'Brien Electric Company, Contracting Engineers.

All of these objectives were accomplished with G & O's first experimental unit. A used semi-trailer in good condition was purchased and repainted a bright red color. The company name and address was added in large letters on each side of the unit. The interior was converted into a stock room, work area and office area with all the features of a home office—telephone, thermostatically-controlled electric heat, fire and burglar protection, fluorescent lighting, and even a time-clock operated electric howler to announce quitting time.

Interior Layout

One side of the trailer interior is equipped with steel shelves and tilted bins for conduit fittings, elbows, boxes, nuts, screws and other wiring accessories. The other side has a large steel workbench complete with convenience outlets and storage space beneath. Up front is the office area with its plan table and racks. High intensity lighting is provided by six two-lamp, 40-watt, industrial type fluorescent fixtures. Electric service facilities surpass those in many homes; consist of a combination panel with a 60-ampere, 2-pole, 110/220-volt, fused, main, pull-put switch and eight branch circuits. All wiring is in E.M.T.

Mounted in the chassis channels underneath the trailer body are six 30-ampere, 2-wire, snap-cover, weatherproof single receptacles (three per side). These provide power for portable cables into the building under construction or for electric tools on workbenches built around the trailer if desired.

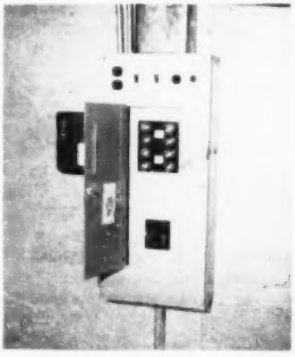
Service entrance (3-wire) consists of a detachable conduit mast (held by two U-bolts) with a base plate and a 60-ampere, 4-wire, grounded, weatherproof receptacle and plug. The service is grounded to the trailer frame and to a driven ground at the service point. During transit, the plug (which feeds the panel) is locked in a metal cabinet under the trailer body. The mast rides inside. While temporary purchased power is normally used, a gasoline-driven generator unit could be used to supply power where temporary facilities are not available.

Two openings on each side of the trailer, near the roof, provide bracket fixture mounting facilities for protective lighting and a little advertising as a by-product.

Transportation

In addition to eliminating the labor normally involved in moving, erecting and dismantling the old job shanty, the trailer provides low-cost transportation of materials. G & O owns no tractors, but has a regular contract carrier haul the unit. On one job, for example, 12 tons of materials were loaded into the trailer at the shop. A contract carrier hauled the locked unit some 35 miles and deposited it at a predetermined location on the job site for about $40—or less than 10 cents per ton-mile. Add to this the fact that the transportation medium is the combination field shop and office, ready for use as soon as it is in place at the job, and you have some idea of the economies involved. Past records indicate that the cost of the trailer can be written off after the unit has been used on three or four jobs. And the cost of the trailer hardly compares with the distinct advantages of novel advertising, inexpensive transportation and ideal quarters.

The first experiment with trailers was so successful that Goldberg & O'Brien now have three units. And chances are that this fleet may be expanded in the future.



DISTRIBUTION PANEL serving trailer has 60-amp main switch and eight branch circuit fuses—more than are in many homes.

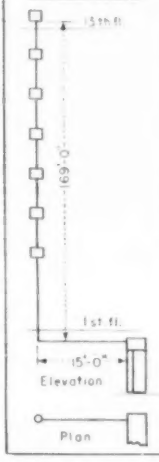
Cable Pulls—Duplicate and Parallel

By Ray Ashley
Research and Consulting Engineer
Chicago, Illinois

QUESTION: *What are (1) Duplicate cable pulls? (2) Parallel cable pulls?*

ANSWER: *(1) Duplicate cable pulls are installations of cable runs which are identical in every respect. (2) Parallel cable pulls are installations of cable runs which have common terminal points. The cables pulled may or may not be of the same size.*

EXAMPLE VI



Size	Cab per Cond.	Hrs. per 100 Ft. First Pull	Group Pulls 2	Group Pulls 3
1	2	4.60	3.60	3.20
1	3	3.30	2.60	2.40
1	4	2.60	2.10	1.90
000	2	6.80	5.10	4.60
000	3	5.00	3.90	3.45
000	4	4.10	3.25	3.00
250M	2	8.60	6.90	6.10
250M	3	6.20	5.00	4.60
250M	4	5.00	3.80	3.50
500M	2	12.00	9.70	8.90
500M	3	8.70	7.10	6.50
500M	4	7.25	6.10	5.60

Cable per Leg

In Cond.	184 ft
Ends	16 ft
Total	200 ft

Studies made in conjunction with the Chicago Electrical Estimators' Assn.

FIG. 1—Table of man-hours for making parallel cable installations shows time economies effected by using same cable pulling equipment "setup" for more than one pull.

DISCUSSION: The study of Duplicate and Parallel Cable Pulls is useful for estimating purposes. Considerable time can be saved by being able to use the same pulling equipment setup for installation of more than one set of cables. It is important to distinguish between the two types of pulls because deductions for "setup time" vary.

For example: all the values given in Fig. 1 are for parallel pulls (cable pulled between the same terminal points). If two No. 3/0 and one No. 1 feeders were to be installed, the time for the No. 3/0 pulling equipment would be figured. The time for pulling the second run of No. 3/0 cable (duplicate pull) would be equal to that for the first, less the time required for moving in, setting up, and removing the pulling equipment. The estimated time for installing the No. 1 cable would be that normally required, less the time required for setting up No. 1 cable pulling equipment. To illustrate we can use values shown in the table.

The length of cable pull (Fig. 1.) is 200 feet. Since we are using three-wire feeders, the amount of cable installed for each pull equals 600 feet. The time required for the first No 3/0 pull is 600 feet at 5-hrs. per 100-ft., or 30 hours.

For the second (duplicate) pull of No. 3/0 cable the time is 600-ft. at 5-hrs. per 100-ft., less 13 hours (equipment time—not shown). The net estimated time totals 17 hours. Average time per 100-ft., for the two pulls (1,200-ft. total) of No. 3/0 cable is (30 hrs. + 17 hrs.) ÷ 12 = 3.9 hours.

The No. 1 cable would be a parallel pull. Estimated time would be 600-ft. at 3.30 hrs. per 100-ft., less 4.25 hrs. (equipment time—not shown). The net time would be 15.6 hours; and the average time, 2.6 hours per 100 feet.

The total time for installing all the cable is estimated as follows:

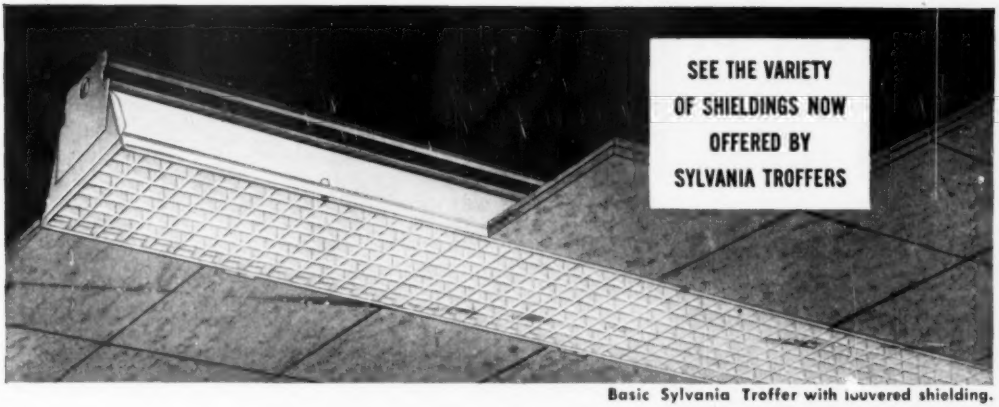
1200 ft. of No. 3/0 at 3.9 hrs. per 100 ft. = 46.8 hrs.
600 ft. of No. 1 at 2.6 hrs. per 100 ft. = 15.6 hrs.
Total 62.4 hrs.

To make isolated installations of the same cables, the required time is figured in this manner:

600 ft. of No. 3/0 at 5 hrs. per 100 ft. = 30.0 hrs.
600 ft. of No. 3/0 at 5 hrs. per 100 ft. = 30.0 hrs.
600 ft. of No. 1 at 3.3 hrs. per 100 ft. = 19.8 hrs.
Total 79.8 hrs.

By taking into account the saving in equipment handling time, the estimated time for the installation is reduced from 79.8 hrs. to 62.4 hrs.; a saving of 17.4 hrs. or 22 percent.

The reader must keep in mind that the values shown in Fig. 1 are for a particular study and can not be used for random jobs without adjustment. The foregoing calculations evolved 13 hours as the time required for moving in, setting up, and removing the pulling equipment for No. 3/0 cable. The time for handling the same equipment varies from 7 to 20 hours, depending on locations and working conditions. A duplicate of the same studies would show variations. Numerous studies of cable installations must be made to get a representative picture.



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PROTECTIVE RELAYING in an Industrial Plant

Selection of a power relaying system to protect a plant distribution system is a problem of cooperation between the serving utility and plant engineer. Here's how Rohm and Haas Company solved the relay problem at their Bridesburg plant.

By Stanley S. Paist
Power Engineer, Rohm & Haas Company
Philadelphia, Pa.

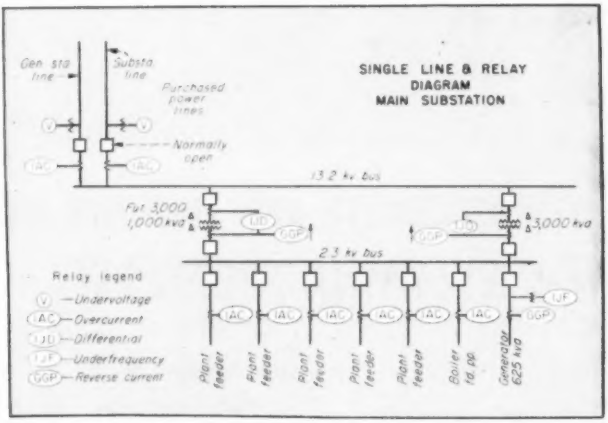

FIG. 1—Single-line diagram showing type and location of relays in the main substation for selective protection of the plant electrical distribution system.

THERE is a definite need for the education of industrial plant management, maintenance engineers, and application engineers on the general theme of adequate protective plant relaying. However, industrial plant relaying is quite properly a problem for the joint action of three distinctly separate but interested forces; (1) the utility supplying the power, (2) the manufacturer who provides the relaying equipment, (3) and the industrial company itself.

We believe joint action is fundamental, and have observed the results of such cooperative effort in actual practice. We recount what we believe is not an isolated case, but an average occurrence where joint, cooperative action has resulted in a mutually acceptable compromise of an industrial relaying problem.

The Bridesburg Plant of the Rohm & Haas Company is neither large from an electrical point of view, nor does its electrical distribution system have a unique problem to present. Actually, the distribution system is small enough so that it does not require the full application of one man's time. It is one of the many functions carried on in the plant Power Engineer's Department. He is responsible to manage-

FUNCTION AND OPERATION OF MAIN SUBSTATION RELAYS

Refer to Fig. 1 single-line diagram for a full understanding of the following description of the major relay operations in the main substation.

Undervoltage Relay—V

The undervoltage relay operates as the voltage, on the line to which it is connected, falls below a specified, predetermined value. The operation of this relay is dependent on time. The inverse-time characteristic prevents operation of the occurrence on voltage changes which are of momentary duration.

Overcurrent Relay—IAC

The overcurrent relay operates when the amperes flowing in the line reach an unsafe, predetermined point. This relay has an inverse characteristic; the higher the amount of overcurrent, the faster the relay operates. These relays may also be equipped with instantaneous devices which operate instantaneously when the current reaches a preset value. Generally, the instantaneous setting is much higher than the usual overcurrent setting.

Differential Relay—IJD

The differential relay is set to operate when the current entering the transformer bank is not balanced by the current leaving the transformer bank. For example, if a fault took place within the transformer bank, the fault current would flow into the bank but not out of it. Under this condition, the relay would operate, opening the circuit breakers both ahead of and behind the transformer bank. In setting the relay, cognizance is taken of the transformer ratio which is inversely proportional to current flow.

Reverse Current Relay—GGP

The reverse current relay is an instantaneous relay which operates when current flows in the direction indicated by the arrow on the single line diagram. This relay is extremely sensitive and operates on low values of power.

Underfrequency Relay—IJF

The underfrequency relay, as its name implies, operates when the frequency falls below that specified. It is an extremely sensitive relay which can be made responsive to as little as one cycle change in the frequency.

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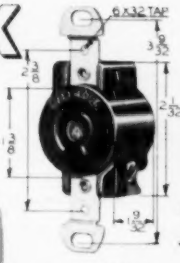

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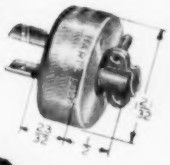

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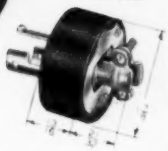

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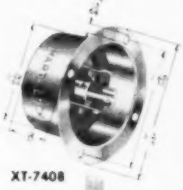

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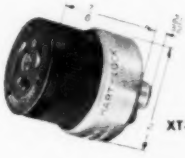

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RELAY SETTINGS

SET, CONTROLLED AND TESTED BY THE UTILITY COMPANY

IAV Voltage Relays—Normal & Emergency Lines
Pot. Trans. 120/1 Type IAV53AIR
Setting 11,160—120/1—93 Volts—1.25 secs. at 0 Volts

IAC Overcurrent Relays—Normal Line
Current trans. 60/1 Type IAC51B
Setting—Instantaneous—Inoperative
Time dial 1.5 Current tap 8

IAC Overcurrent Relays—Emergency Line
Current trans. 60/1 Type IAC51B
Setting—Instantaneous—40 Amps.
Time Dial 0.40 Current tap 8

GGP Power Directional Relay on 3,000 KVA Transformer
Pot. trans. 20/1—Current trans. 240/1—Type GGP51AIR
Upper element (IAV) 1860—20/1—93 Volts—0.8 time dial (100 Cy)
Lower element (CAP)—24 KW

GGP Power Directional Relay on 1,000 KVA Transformer
Pot. Trans. 20/1—Current trans. 60/1—Type GGP51AIR
Upper Element (IAV) 1860—20/1—93 Volts—1.0 time dial (100 Cy)
Lower Element (CAP)—6 KW

SET, CONTROLLED AND TESTED BY THE PLANT ENGINEERING DEPARTMENT

IJD Differential Relays on Transformer Banks
Type IJD 53AII

	3000 KVA Bank		1000 KVA Bank	
	13.2 KV	2.3 KV	13.2 KV	2.3 KV
C.T. ratio	30/1	240/1	10/1	60/1
Relay taps	4.6	3.2	4.6	4.2

Original factory setting for pick up current was readjusted from 0.4 to slightly less than 1.0 times tap setting to prevent magnetizing current from operating relay.

IJF Underfrequency Relay—Generator
Type IJF51B
Set at 57 Cycles

GGP Power Directional Relay—Generator
Pot. Trans. 20/1—Current trans. 40/1—Type GGP51AIR
Upper Element (IAV) 1860—20/1—93 Volts—1.5 time dial (300 Cy)
Lower Element (CAP) 4 KW

IAC Overcurrent Relays—All 2.3 KV Plant Feeders (5)
Current Trans. 60/1 Type IAC51A
Setting—Instantaneous—Inoperative
Time dial 1.00 Current tap 16

IAC Overcurrent Relays—Boiler Feed Pump and Process Water Pumps

Current trans. 10/1 Type IAC66B
Setting—Instantaneous—25 Amps.
Time dial 2.00—Current tap 3.1

IAC Overcurrent Relays—Main Building 38 Breaker
Current trans. 30/1 Type IAC51B
Setting—Instantaneous—Inoperative
Time dial 0.50—Current tap 16

IAV Voltage Relays—Boiler Feed Pump and Building 38 Pump Breakers
Pot. Trans. 20/1 Type IAV53BIR
Setting—1100—20/1—55 Volts
Time dial Factory set about $2\frac{1}{2}$ sec. at 0 Volts

ment for the application engineer's activity and the maintenance engineer's activity; for periodically reviewing all parts of the plant electrical costs, and justifying to management the expenditure of the money he believes necessary for the proper operation of the electrical system. In his position he can evaluate, from a manager's viewpoint, the economic results of adequate plant relaying.

Rohm & Haas' Bridesburg Plant consists of approximately 50 buildings located on approximately 60 acres. Some of these are quite small and others consist of four and five stories. Electric power is distributed over 3-phase, 2.4-kv delta distribution circuits and is stepped down to 3-phase, 230-volt delta or 208/120-volt wye for motor and lighting loads respectively. At present there are about 15-300 kva load centers to supply the 230-volt motors and about 8-150 kva load centers for the lighting load.

Approximately 2,100 motors have a combined capacity of 7,150 hp. About 900 hp operates at 2.4 kv; the remainder at 230 volts. The largest motor is 200 hp (2.4 kv) but most are of the 2 to 5 hp size. In addition, there are approximately 1,100 kw of lights and 600 kw of electric heater load. Less than 1% of the power delivered by the plant distribution system is unmetered.

To supply this diverse load, the plant purchases most of its power from the local utility system at 13.2 kv and steps it down to 2,400 volts through two transformer banks, one rated at 3,000 kva, the other at 1,000 kva. The latter bank may be easily replaced with a 3,000 kva bank as future load growth demands. In addition, about 25% of the demand is supplied with a turbine generator (used to provide the plant with two steam pressures by reduction through a turbine).

Selective Protection Problem

Obtaining selective protection in the various electric circuits at the Bridesburg Plant became a problem due to the low time-current relay settings normally permitted by the utility on the incoming power supply. Close cooperation of the utility and the customer resulted in a satisfactory compromise.

Those few relays which were in operation were designed primarily to protect the utility supply rather than the plant system. For this reason, a major fault disturbance within the plant usually resulted in the complete loss of the utility service. This was both costly and generally avoidable.

During World War II, the plant electric load had grown to a point where system reliability was not keeping abreast of plant production requirements. A few minor relay changes were adopted. Since basic system design, production load requirements, and equipment shortages did not permit major alterations to the distribution system, it was not until later during an electrical system expansion to meet increased plant demands, that the present relay installation was finally completed. While no major relay alterations were made during the war, several 2.4-kv to 230-volt plant power centers were added. These load centers were designed carefully to provide selectivity within the center as well as to fit into an overall plant scheme.

Selling the Relay Idea

Two important concepts were recognized and formed the basis for the relay scheme. First, improved reliability became increasingly important as the system grew larger. Second, the probability of faults in the system would

(*Continued on page 92*)

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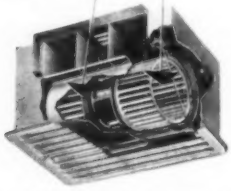

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BUT QUALITY OFFERS A REASON

TRADE-WIND MOTORFANS, INC.

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Protective Relaying in an Industrial Plant

. . . *Starts on page 88*

tend to rise in proportion to the size of the system. The possibility that a past history of few system disturbances might act to dull management views regarding capital investment for providing standby equipment and protective relaying was not neglected. Our design was not permitted to run ahead of our ability to sell the reliability angle to management where past plant history did not readily support our concepts. Emphasis was placed on adequately designed equipment. This proved important for it not only diminished the probability of faults occurring but also helped secure concessions during our discussions with the utility concerning selective relaying.

Because the utility supply carried about 75% of the demand, the reliability and relaying of the utility system was carefully studied to determine to what extent we should relay our plant system; also the problems of coordinating plant relays with the utility system.

Some of the major problems which arose could be solved only by joint action between the utility and the customer. This required a full and complete exchange of information regarding equipment specifications, proposed relay schemes, future planning, and general maintenance schedules. The utility apparently recognized that, as customers take larger blocks of purchased power, selective relaying within the customer's premises becomes more important. For our part, we recognized the problems confronting the utility in protecting their system by preventing troubles on a customer's equipment from creating disturbances which would affect other customers fed from the same line. Our selective relaying scheme was based on the same principles—*faults must not remain on the system long enough to damage equipment unduly or to cause wide system disturbances.* In this way, equipment not directly involved will continue to function. By adequate maintenance programs, by careful design in consultation with the utility and by the use of adequately designed equipment, much was done to influence the utility to permit higher than normally allowed time-current settings on our substation relays. However, the fact that we were served by a line directly from a generating station probably was most instrumental in allowing us to achieve a better, more reliable, electrical system.

(*Continued on page 94*)

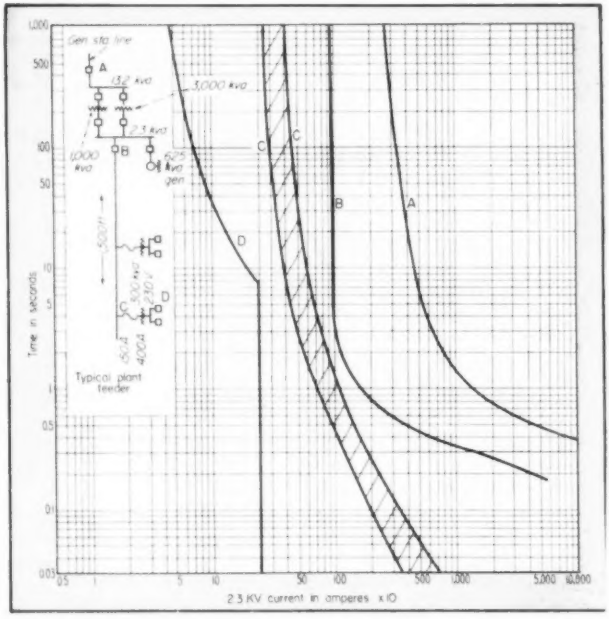
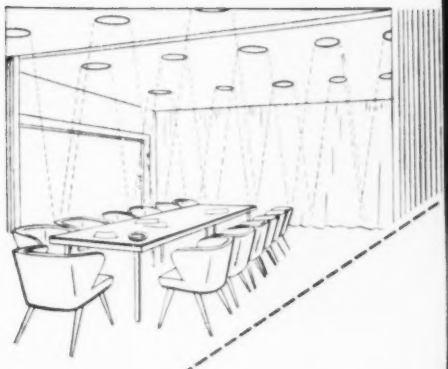
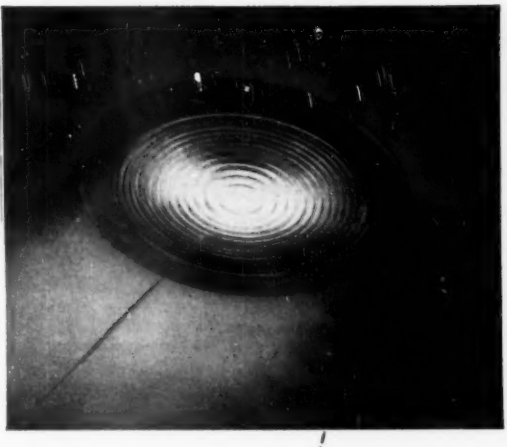


FIG. 2—Time-current curves of overcurrent protective devices on a typical plant feeder as sketched on chart. Interrupting ratings of protective devices are adequate for maximum fault current interruption.





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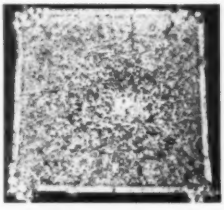

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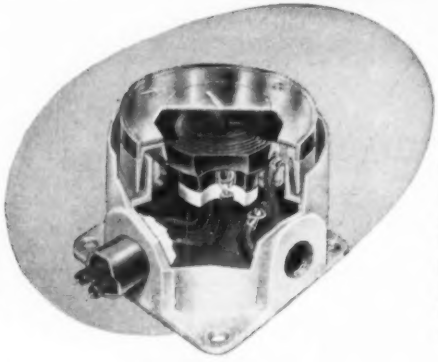

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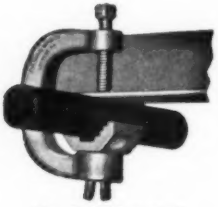

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ECONOMICAL

Protective Relaying in an Industrial Plant

. . . *Starts on page 88*

The Relay Scheme

Fig. 1 indicates the general relaying and the single line diagram of the equipment installed in the plant substation.

An important part of the relaying scheme was the obvious but rather involved problem of having the incoming 13.2-kv utility line overload relays set with sufficiently high time-current and instantaneous characteristics to allow the 2.4-kv bus distribution circuit breaker overcurrent relays enough leeway for selective operation. The utility was at first quite reluctant to increase their standard time settings on either of the incoming lines. Fortunately, the normal service 13.2-kv purchased power line originated at a generating station. Since the line relays at the generating station were, so to speak, next to the relays on the line entering our substation, selective tripping could be obtained by merely holding our relays under the time of the generating station relays. The emergency 13.2-kv purchased power line originated at a utility company substation and interposed the utility substation relays between the generating station and our substation.

The utility considered this situation carefully for a few months. They finally decided to increase the time-current and instantaneous characteristics of our substation relays on the normal supply line, but not to increase the settings on the emergency line originating at their substation since their selectivity would have been somewhat affected by this further acquiescence to our request. Full use was made of the increased time settings allowed on the normal line. This was done with the knowledge that, during short periods when the emergency line would supply the plant load, we could tolerate questionable relay selectivity under certain fault conditions.

The high-side fuses and low-side circuit breakers of our 2.4-kv to 230-volt and 120-volt power centers fitted into the overall selectivity picture as may be seen from the overcurrent protective devices' time-current curves shown in Fig. 2. The letters identifying the curves refer to the various protective devices shown and designated on the sketch of the typical plant feeder line.

(*Continued on page 96*)

INSTALLATION: Fanny Farmer Candy Store, 50th St & 6th Ave., New York City, New York.
DESIGNER: Lippincott & Margulies
ELECTRICAL CONTRACTOR: Reksal Electric Company.
FIXTURES: Litecontrol Luminous Lens Ceiling Panels, 45" x 48", each using 4-3 lamp 48" slimline fixtures, and 16 Holophane No. 9015 lenses in lucite frame.
WATTS PER SQUARE FOOT: 3.1.
APPROXIMATE REFLECTANCES: Wall (Wallpaper), 63%. Floor (Beige-grey terrazzo), 10%.
AVERAGE INTENSITY: 63 footcandles initially at counter height.
BRIGHTNESS: (One of center lenses).
Normal to lamps, at 30°, 1.0 candle per square inch.
at 45°, 2.07 " " " "
Parallel to lamps, at 30°, 1.0 " " " "
at 45°, 1.99 " " " "

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Lighting by LITECONTROL is an important member of the sales staff in this Fanny Farmer store.

LITECONTROL'S Luminous Len Ceiling Panels bathe every surface in a flattering, even illumination . . . show merchandise in its *best* light, without ugly shadows, glare or harsh contrasts.

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4. **IT INSULATES** the splice with a phenolic plastic shell that withstands 4000 volts dielectric and air gap tests.

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CITY_____ ZONE____ STATE_____

Protective Relaying in an Industrial Plant

. . . *Starts on page 88*

Current has been plotted against a 2.4-kv base as a matter of convenience. The interrupting ratings of the protective devices indicated are, of course, adequate for maximum fault current.

The table of Relay Settings records the vital statistics for all of the relays indicated on the single line sketch. Five of the plant relays are completely set and tested by the utility company. These were installed at the request of the utility company, since they serve no useful function as far as the plant service continuity and protection are concerned. The remaining relays are maintained and tested by the plant. *All settings are checked annually and all relays are thoroughly inspected and maintained on an annual basis.*

How the System Works

Under normal operation, the Rohm & Haas Plant is fed from the generating station line with the small plant generator operating in parallel with the utility on the 2.3-kv bus. Under these conditions, with a fault on one of the plant feeder lines, the overcurrent relay on that feeder would operate and open the circuit breaker on the plant feeder. The same fault current which is flowing in the faulted feeder would obviously flow through the generating station line circuit breaker. An additional amount of fault current would also be contributed by the plant generator. Because there is no overcurrent relay on the plant generator, the fault on the feeder line would not cause any circuit breakers to open in the plant generator feed. Because the overcurrent relays on the generating station line are made selective with the overcurrent relays on the plant feeder line, the plant feeder line overcurrent relay would operate ahead of the generating station line overcurrent relay and clear the fault before the generating station line overcurrent relay operated. Under these conditions, selectivity between the two overcurrent relays, one on the generating station line and the other on the faulted feeder line, would result in isolating the faulted line.

If a fault should take place on the generating station line outside the plant property, the sequence of operation would be as follows.

(*Continued on page 98*)

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CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

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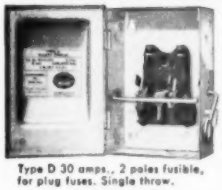
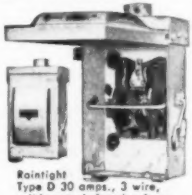


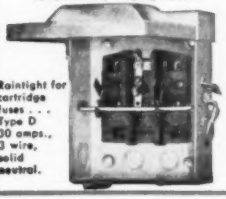
Type D 30 amps., 2 poles fusible, for plug fuses. Single throw.

Type D 30 amps., 3 wire, solid neutral, for plug fuses. Single throw.

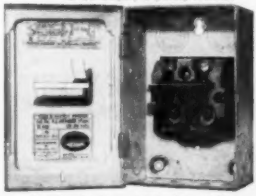


Raintight Type D 30 amps., 3 wire, solid neutral, for plug fuses.

For cartridge fuses . . . Type D 30 amps., 3 poles, fusible.



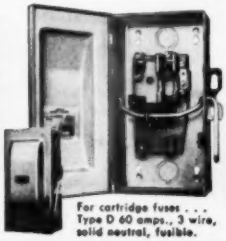
Raintight for cartridge fuses . . . Type D 30 amps., 3 wire, solid neutral.



D-Puller Front operated— Type D for plug fuses, 30 amps., 2 poles.

EXTRA VALUE AT NO EXTRA COST

CUTLER-HAMMER
SAFETY SWITCHES
C-H



For cartridge fuses . . . Type D 60 amps., 3 wire, solid neutral, fusible.

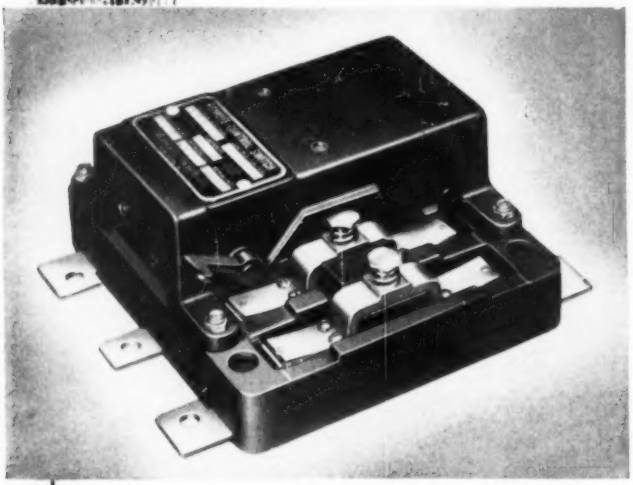
Front operated— Type D for cartridge fuses, 60 amps., 3 wire, solid neutral.

***A CONTROL MUST FOR HIGH BAY LIGHTING**

. . . instant disconnect of lighting and power feeders from remote panel

***THE SWITCH TO PROVIDE THIS SERVICE!**

. . . the ASCO Remote Control Switch now made in capacities up to 1000 amperes



Are you laying out the electrical circuits for a large building—a factory—a hangar—an auditorium—an institution? Buildings with extensive high-lighted working bays?

Instant remote disconnect of lights and power circuits is a "must", if both safety and economy are objectives.

Remote controls for instant disconnect protect workers and machinery. They eliminate multiple heavy feeder lines thus saving on installation costs.

The ASCO Line of Remote Control Switches, similar to the switch illustrated, now ranges up to 1000 amperes in capacity. Write us about your requirements.

Electromagnetic Controls For All Industry

We also manufacture a complete line of Solenoid Operated Valves for Automatic and Remote Control of Liquids and Gases.

5521

ASCO Electro-Magnetic CONTROLS

Automatic Switch Co.

385 LAKESIDE AVENUE • ORANGE, NEW JERSEY

Protective Relaying in an Industrial Plant

. . . Starts on page 88

When the fault occurred, the utility circuit breakers feeding the generating station line would open. Low voltage on the generating station line, however, would not immediately be apparent because the small plant generator would, in conjunction with the utility generators, also attempt to feed the fault and thus hold up the voltage on the 13.2-kv bus. To do this, the plant generator would have to backfeed through the main transformer banks. In doing so, they would operate the reverse current relays on the low voltage circuit breaker on each of the transformer banks. This operation would disconnect the plant generator from the 13.2-kv bus thus permitting the voltage to fall to zero and operate the undervoltage relays on the generating station line. Since the undervoltage relays are interlocked with the circuit breaker on the generator feed, as they operate they would clear not only the generating station line from the system but plant generator as well, thus dropping all sources of electric power to the plant substation.

Should the small capacity of the plant generator be insufficient to supply the still energized plant feeders as well as backfeed the fault on the generating station line, the reverse current relays on the 2.4-kv side of the plant transformers might not receive a sufficient flow of power to cause them to operate. In this case, the plant generator, being unable to supply the plant load and fault, would slow down. As it slowed down, its output frequency would drop thus operating the underfrequency relay and clearing the generator from the system.

With the generating station line and plant generator cleared, it would remain but to have the operator energize the emergency line to re-establish power to the plant and parallel the plant generator on the 2.3-kv bus to return the substation to normal. The reverse current relay on the generator would also protect the turbine from internal damage due to a motoring generator.

We firmly believe that careful relaying will pay dividends to plant management by preventing widespread system disturbances and that industrial plants, even small ones like the Bridesburg Plant, should not neglect this phase of their electrical system.

DRIVE-IT speeds electrical fastening in Alaska hospital

Junction boxes, switch panels, conduit and other fixtures were anchored to concrete with DRIVE-IT in the Native Service Hospital, Anchorage, Alaska. Electric Smith Co. of Spokane, Washington, the electrical contractor on this job, chose DRIVE-IT as it is the fastest, most economical method of fastening to concrete or steel.

Worker using DRIVE IT 300 to secure electric control panel to concrete wall.

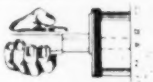
split-second fastening to concrete steel

Drive-It uses a small powder load to drive hardened steel pins into concrete or steel. No power lines! No drilling!

UL

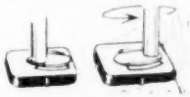
DRIVE-IT, the *first* powder actuated tool approved by Underwriters' Laboratory.

DRIVE-IT cannot be discharged accidentally due to the push and turn sequence. This, plus the large safety pad makes *DRIVE-IT* triple safe.



Exclusive Automatic Barrel Extension for fastenings inside junction boxes or other recesses.

DRIVE-IT is the only powder-actuated tool which requires but one standard power load regardless of penetration desired.



Exclusive Swivel Safety Pad easily rotated for getting into close quarter work.

DRIVE-IT "300", lowest cost fastening tool. Low original cost and low operating cost.

OVER 50 TYPES AND SIZES

See our display, **PLANT MAINTENANCE SHOW,** Cleveland, January 19-22, 1953.

MAIL THIS COUPON TODAY!

POWDER POWER TOOL CORP.

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☐ Please send FREE catalogue and literature.
☐ I want a FREE demonstration of *DRIVE-IT*

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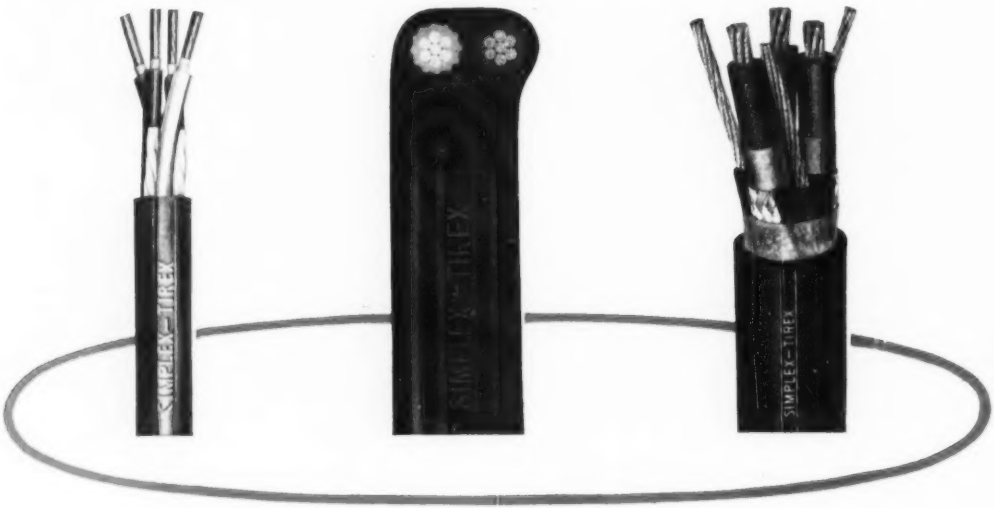
TIREX IS A FAMILY



To a great many people the name "TIREX" means a small, flexible, long-wearing portable cord. Actually, TIREX is the name of a family of portable cords and cables. The family ranges in size from a single conductor #18 cord, all the way up to a 3-conductor Type SH-D cable for voltages in excess of 10,000 V.W.P.

TIREX cords are made in sizes from 18 to 10, from single to eight conductors in Type SO, and from two to four conductors in Type SJO. There are TIREX Mine Cords, as well as heavy duty shielded cords.

In the cable field there are single and multi-conductor cables, shielded or unshielded, Types W or G, SH-A, SH-B, SH-C and SH-D.

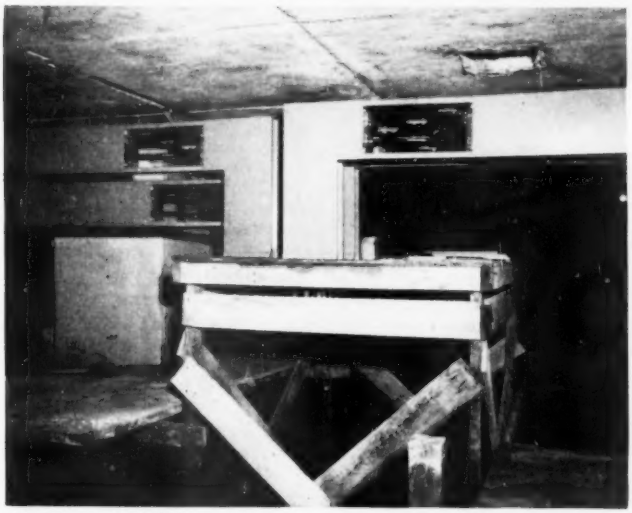
Your local distributor has many of the TIREX cords and some of the TIREX cables in stock. He can get most of the other stock type TIREX cords and cables for you in a comparatively short time. Be sure to see your local distributor whenever you need portable cords and cables.

SIMPLEX-TIREX IS A PRODUCT OF SIMPLEX RESEARCH

SIMPLEX-TIREX

SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS.

Practical Methods



PERFECTLY ALIGNED and rigidly supported by platform template, these feeder bus duct terminations await arrival of distribution switchgear. In the interim, the complete bus duct system was installed.

Platform Template Supports Feeder Duct

CONSTRUCTION

It's not unusual for switchgear to be the last heavy equipment to be installed on an electrical construction project. In fact, with today's long delivery schedules, it's the rule rather than the exception. This was the situation encountered on an industrial plant project by Westphal & Company, electrical contractors of Janesville, Wisconsin.

Installation of feeder bus duct could not wait on switchgear delivery. Everything had to be ready for immediate connection as soon as the gear arrived.

So the complete bus duct system was installed as soon as building construction progress permitted. Actually, temporary power was fed back over some of the duct lines to provide electrical energy for the various construction trades on the job.

Bus duct installation can become a very critical operation with respect to measurements and dimensional accuracy, particularly at switchgear cubicle entrances when the cubicles are not in place. To assure a perfect fit at cubicle locations, Westphal mechanics built a wood platform support and template in the cubicle "pits" in the building basement. Actual factory layout and dimensional data were transferred to the platform. Openings and mounting holes were cut and the feeder duct was rigidly secured to the platform. With this as a starting point, the rest of the duct lines were installed.

When the switchgear arrived on the job, the platform-templates were removed, and the cubicles were installed. Careful planning and use of the templates paid off in a perfect fit and quick connection of the feeder duct ends.

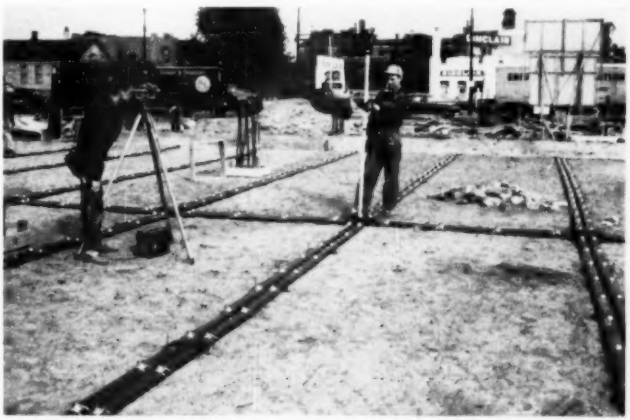
Use Surveyor's Level To Speed Duct Work

CONSTRUCTION

The surveyor's level is an instrument that is rapidly finding a place in the increasingly long list of electrical contractors' job tools. In particular, those contractors doing work in the industrial and commercial field should not be without it. That is the feeling of J. W. Zinaveah and R. G. Walsh, engineers with Goldberg & O'Brien Electric Company, contracting engineers of Chicago. Among other uses, they have discovered how effective this instrument can be in leveling underfloor duct installations.

Previously, G & O men used conventional methods to bring underfloor duct boxes and inserts up to finished floor level. Usually this meant running a taut string or wire between junction boxes set to grade and raising the connecting duct to string level. If the job were to be accurate, the sag of the string or wire had to be taken into account. They were limited to about a 50-foot run and the string had to be set up for each run of duct, a time-consuming detail.

On a recent Chicago project involving a substantial quantity of underfloor duct, G & O management decided to try the surveyor's level. The result surpassed even their fondest hopes. A three-man crew, working with a level, rod and adjusting screwdriver, leveled 2,400 feet of duct in about six hours. And the effective area of operation was extended from the previous 50-foot



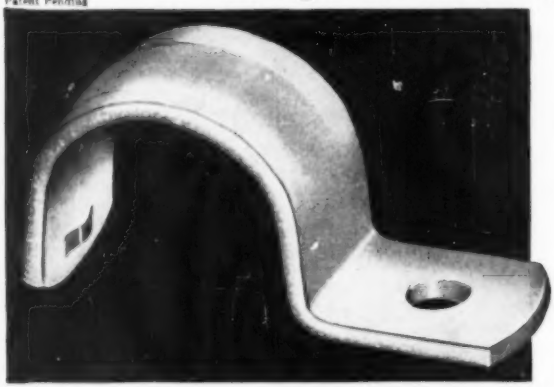
SURVEYOR'S LEVEL in use to check level of underfloor duct prior to concrete pour. Instrument man sights on stationary, permanent target on rod which is placed on top of duct inserts or junction box covers.

FOR FASTER INSTALLATION
Specify and Install

Blackhawk Industries SNAP STRAP

for rigid and thinwall conduit

Patent Pending

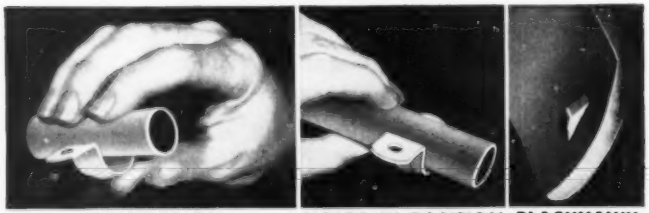


Exclusive self-holding feature saves time, eliminates fumbling and dropping, makes difficult installations easier.

Made of heavy gauge steel, zinc plated after fabrication. Wide range of sizes for rigid and thinwall conduit.

Ask for SNAP-STRAPS for all your conduit jobs.

Sold only through electrical wholesalers



SNAP IT ON HOLDS IN POSITION BLACKHAWK HAS IT

BLACKHAWK INDUSTRIES DUBUQUE, IOWA

Blackhawk Industries

Entrance Cable Fittings • Fluorescent Brackets • Staples
Cable and Conduit Straps • Yard Lights • Box Supports
Connectors • Wire Holders • Locknuts and Bushings
Sill Plates • Conduit Entrance Caps

DUCT IS RAISED or lowered until rod target coincides with cross-hair on level instrument. Third man adjusts duct leveling screws up or down on signal from instrument man. Once set, level tripod remains in same position.

limit to a radius of about 400 feet around the instrument location. Once the instrument was set, they could continue until quitting time.

The surveyor's level is comparatively simple to use on this type of work. The level and tripod are set up in a convenient location. The rod man sets his rod on the finished-floor benchmark (stake, etc.) provided by the general contractor. The instrument man takes a foresight on the rod and the target is adjusted until its marker coincides with the cross-hair on the level. This is the permanent target.

The rod man goes about the duct lines, placing his rod on top of inserts and junction box covers. As the instrument man sights on the target, he signals the third man adjusting the duct. If the target is too low, the duct must be raised by turning the leveling screws on the duct supports. If the target is too high, the duct must be lowered.

On projects where the duct is laid on a dirt fill, bricks and similar "bases" are placed under the duct to approximate finished grade. Final leveling and adjusting are accomplished by using the surveyor's level. Normally, the rough adjustment is done when the duct is laid and is not considered part of the final leveling operation.

Do the men on the job like this scheme? As one job superintendent put it: "We don't know how we ever got along without it."

Hand Truck for Circuit Conductors

MATERIAL HANDLING

Mobility of supplies is one idea that Clarence Brown, manager, Westphal & Co., Janesville, Wis., applies on all of the company's electrical construc-

Sailor Beware! The Old Man of The Sea!

WHO has not read of Sinbad, as told in the Arabian Nights by glamorous Scheherazade?

Shipwrecked on a strange island, the unfortunate sailor came upon a weak old man. Moved by compassion, Sinbad took the feeble fellow on his back, carried him over the brook, gathered fruit and fed him. But when Sinbad asked him to get down, the old man refused, wrapping his legs about his neck, almost strangling him.

The sailor fainted and fell down, yet the old man clung ever closer. He rained blows on Sinbad, driving him about without rest, to pick fruit and do his pleasure. This went on and on, until the desperate sailor made wine from wild grapes to appease his own plight. One day noting Sinbad's pleasure, the old man snatched a gourd of wine and gulped it down. Completely drunk, he loosened his grip and Sinbad threw him off. Saved by a passing ship, his rescuers said, "You are the first ever to escape strangling by the Old Man of the Sea".

Dating back hundreds of years, the Old Man is an allusion familiar to everyone. He is a warning figure today. Our nation, surviving the storms of two world wars, wanders down strange ways. With kindly intent and glorying in its own strength, America is tempted to shoulder the Old World and its age-worn problems. But weak and feeble as the Old World appears to be, let us beware! How easy to assume a burden which would quickly exhaust our strength, strangle us as a nation, and in the end leave the world as weak and exhausted as it was before our foolish undertaking!

QUALITY YOUNGSTOWN SERVICE

The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio

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MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

RAILROAD TRACK SPIKES - CONDUIT - HOT AND COLD FINISHED CARBON AND ALLOY BARS - PIPE AND TUBULAR PRODUCTS - WIRE - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - RODS - SHEETS - PLATES.

When servicing costs are high as the lights...

Lower Both Lights And Costs With Thompson Hangers!

You're losing money when you use two men and a lift truck to service lighting fixtures . . . *and you're risking someone's neck!* THOMPSON disconnecting and lowering **HANGERS** facilitate rapid, safe, efficient floor-level maintenance of high-bay lights.

You can assure maximum round-the-clock lighting efficiency by following a planned maintenance program. And remember . . . *there is no faster, safer or more economical means of servicing overhead lights than with THOMPSON HANGERS. Simple manual operation is exercised at floor level.*

Write today for new illustrated Bulletin TH52 for additional details.

664-TE

1. DISCONNECT 2. LOWER 3. SERVICE 4. REPOSITION 5. REPEAT

THE THOMPSON ELECTRIC CO.

1157 POWER AVENUE • CLEVELAND 14, OHIO

EASY TO ROLL reel truck holds 3,000 feet of branch circuit conductors of different colors (six, 500-ft. coils). One man can move unit anywhere within a construction project.

tion projects. And it pays off on the credit side of the man-hour ledger. Better employee morale is another plus feature. A mechanic who doesn't have to "lug" equipment around a project is a less fatigued and more efficient workman throughout the day.

One example of this is the hand truck used to move branch circuit conductors from place to place on a recent industrial plant project in Wisconsin. With it, one man can take six coils of wire from room to room, or over short or long distances, and have the conductors set up ready for the wire-pulling crew in a minimum time.

It is nothing more than a triangular-shaped, free-standing rack made of angle iron and mounted on two-rubber-tire wheels. A broad base frame keeps the rack upright when it is in a stationary position. Two conduit handles, welded to the top of the rack provide an easy grip for the mechanic to tip the assembly back on its wheels and move it wherever it is needed.

Coils of wire (500-ft. lengths) are placed on octagon-shaped plywood reels, one coil per reel. Each of two cross-bars on the front of the rack holds three reels. Westphal mechanics like the hand reel truck; find that it simplifies multi-conductor circuit installation, particularly where several different colors of wire are required.

Wooden Rig Speeds Vertical Drilling

CONSTRUCTION

A simple rig, on the lever and fulcrum principle, can add speed and ease to overhead vertical drilling jobs. In combination with a power drill or

DELCO
DAYTON OHIO

whatever the application,

you're right with a

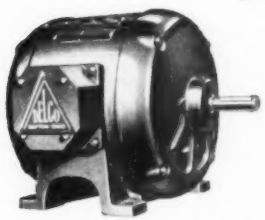
DELCO!

When your product requires the application of power—as a part of the product or to help make the product—you can be sure of complete satisfaction by choosing the Delco motor that's *built* for the job.

Every Delco motor that's made is engineered for the kind of *work* it has to do. It's made of the finest materials, and constructed to *stand up longer* under the roughest conditions.

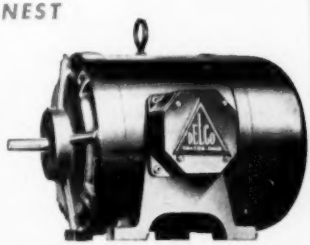
So get the facts on Delco motors *first.* You'll find Delco has the motors you need, and that Delco always meets its commitments. For complete details, write to Delco Products, Dayton, Ohio, or call the nearest sales office listed below.

DELCO FEATURES MAKE DELCO FINEST



OPEN BALL-BEARING MOTOR

TOTALLY ENCLOSED FAN-COOLED MOTOR



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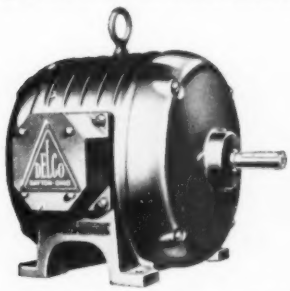
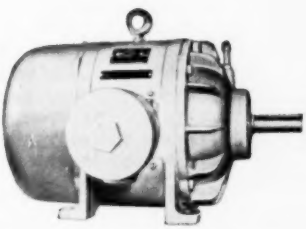


TOTALLY ENCLOSED MOTOR

EXPLOSION-PROOF MOTOR



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DELCO PRODUCTS

DIVISION OF GENERAL MOTORS CORPORATION, DAYTON, OHIO

NEW AUSTIN FORMED TYPE BOX HANGERS

3900 Series

Strong and lightweight, yet flexible enough to permit perfect alignment of box

MADE OF GALVANIZED STEEL—IN ALL STANDARD LENGTHS AND DEPTHS

PATENT PENDING

No. 3900 STRAIGHT

No. 3904 1⅛" OFFSET

No. 3905 1¼" OFFSET

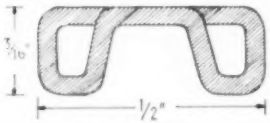
No. 3915 1⅛" OFFSET

No. 3916 Bayonet Type

No. 3917 S UNIVERSAL

Licensed under Pat. No. 2,246,189

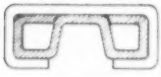
Dimensions of formed type box hangers are the same as solid type



Adjustable Formed Type Hanger

No. 3918 Hanger

Adjustable from 14⅜" to 19"



Cross section view of No. 3918 formed type box hanger.

This new two piece hanger is designed so that one part telescopes into the other. Requires no notching of joists. Is quickly adjustable between joists and to any depth. Length can be extended from 14⅜" to 19".

WRITE FOR FREE SAMPLE FORMED TYPE BOX HANGER—*check coupon and mail today!*

THE M. B. AUSTIN COMPANY, NORTHBROOK, ILL.

Please send FREE sample Box Hanger checked below:

- ☐ 3900 STRAIGHT 18" BOX HANGER
- ☐ 3904 1⅛" OFFSET 18" BOX HANGER
- ☐ 3905 1¼" OFFSET 18" BOX HANGER
- ☐ 3915 1⅛" OFFSET 18" BOX HANGER
- ☐ 3916 BAYONET TYPE 16" BOX HANGER
- ☐ 3917 "S" UNIVERSAL 14½" BOX HANGER
- ☐ 3918 ADJUSTABLE 14⅜" TO 19" BOX HANGER

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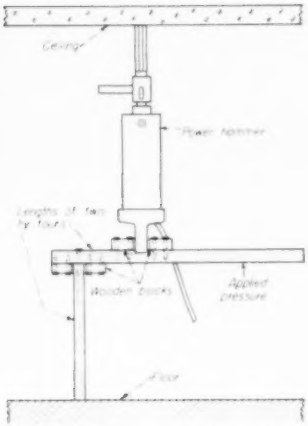


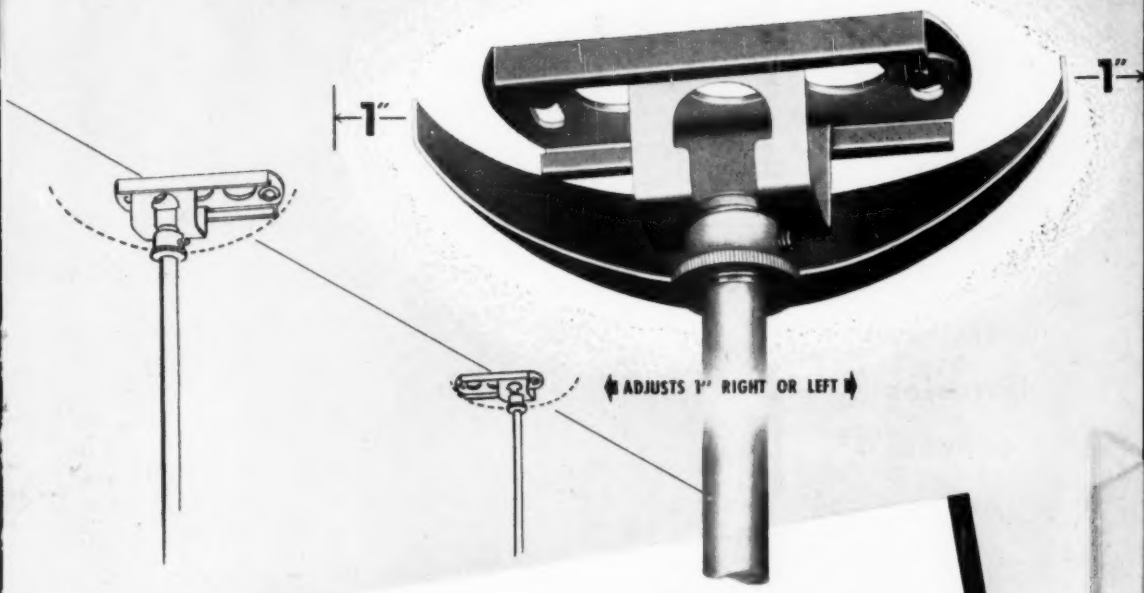
DRILLING RIG consists of lengths of scrap lumber assembled on the lever and fulcrum principle; provides quick and easy drilling of ceilings.

power hammer, the wooden assembly minimizes the fatigue of the operator and greatly increases the drilling rate. This method is applicable in drilling of moderate height ceilings and requires a second person to handle rig.

As shown in the sketch, the rig consists of two lengths of scrap lumber, usually lengths of two-by-fours, fastened in an "L" shape. The length of the vertical piece is selected to assure that the end of the drill will penetrate the thickness of the ceiling. The horizontal member should be of length sufficient to avail an appreciable mechanical advantage when pressure is applied at its end. Wooden blocks are used to strengthen the joint between the two members and also to form a cradle for the end of the power tool.

In use, the drill is placed against the ceiling, with its end supported between the cradle blocks on the horizontal member. As the drill operator guides the drill, the second person applies the pressure at the end of the lever. The hole is then easily drilled with a minimum of effort.

TEXANS at NECA's Chicago conclave included I. N. Hargis, Hargis Elec. Co., Brownsville; J. C. Thompson, Thompson Elec. Co., Mission, and W. B. Schnorbus, W. B. Schnorbus Elec., Houston.



MOUNTING POINTS OUT-OF-LINE? No Matter! New Wakefield Adjustable Ceiling Straps Correct it for You!

You don't need to waste time drilling new holes to remount straps that are slightly out-of-line. New Wakefield Adjustable Ceiling Straps slide over—up to 1" in either direction. Now standard on all Wakefield fluorescent and incandescent single-stem hangers, these straps are another example of Wakefield's "Design for Contractors" to save time on every job. Here are three additional conveniences of the new straps:

1. They mount on ceiling outlet boxes or pre-installed studs, or directly on ceiling with one or two toggle bolts.
2. They have the famous Wakefield hook-on connection, to which stems can be attached instantly.
3. They can be used with the new Wakefield 35° swivel for sloping ceilings. They take all accepted mountings without adapters.

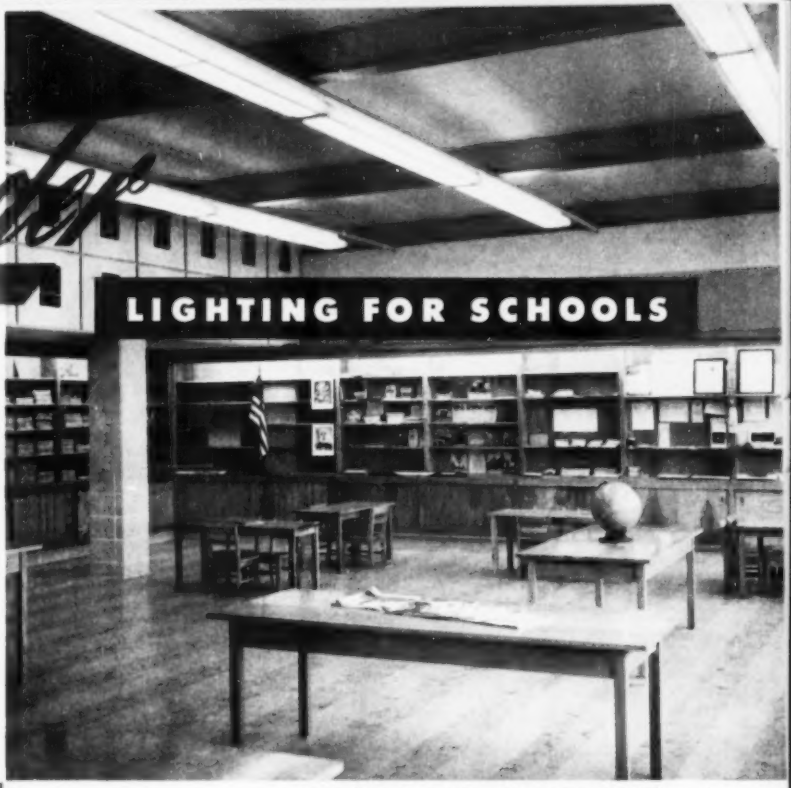
Wakefield Adjustable Ceiling Straps are made of 16 gauge steel zinc plated to resist rust, and take a 400 lb. load. We'd be pleased to tell you more about Wakefield Adjustable Ceiling Straps, and about the Wakefield Luminaires on which they are used. For information, write The F. W. Wakefield Brass Company, Vermilion, Ohio.

Designed for Contractors by.... Wakefield

Over-ALL Lighting

Leader

LIGHTING FOR SCHOOLS



classrooms

libraries

offices

lecture rooms

gymnasiums

corridors

Leader OFFICER installation, using 2-lamp 96" Slimline units. Translucent plastic side panels, 45° plastic egg-crate louver.

The first choice where the demand is for the finest! Available for 2, 3 or 4 lamps, either 40-watt or Slimline in 48", 72" or 96" length. Moulded plastic louver with 45° or 31° shielding. Choice of curved translucent plastic or steel side panels.

VL-440
LEADER OFFICER

PLB-240
LOW-BRIGHTNESS UNIT

Plentiful light for continuous close seeing! True parabolic reflectors of diffused Alzak aluminum combine with T-17 lamps to assure maximum light output, low surface brightness, and freedom from glare. Uses two 60" tubes.

Outstanding for general school lighting! Economical in cost, but a "luxury" fixture in appearance and performance. Baffle-type louver provides 25°-35° shielding. Uses two lamps, either 40-watt or Slimline in 48", 72" or 96" length.

V-240
LEADER VARSITY

● FROM KINDERGARTEN TO THE POSTGRADUATE LEVEL . . . Leader stars in lighting for schools. Scientifically controlled light diffusion, minimum shadows, and absence of glare provide ideal seeing conditions. Leader fixtures are beautifully styled and superbly efficient in operation. Economical to install and easy to service, too.

The wide variety of correctly designed Leader fixtures assures the *right* light for every need, from top to bottom of the school plant. Three of the most popular Leader units for schools are shown and described at the left. Complete information on these and other Leader fixtures available on request to all who are interested in the best in school lighting.

Sold and installed by the better electrical wholesalers and contractors

Leader — *America's No. 1 Lighting Equipment Manufacturer*

LEADER ELECTRIC COMPANY • 3500 North Kedzie Avenue • Chicago 18, Illinois
Leader Electric—Western • 800 One Hundredth Avenue • Oakland 3, California
Campbell-Leader, Ltd. • Brantford, Ontario • Canada

Modern Lighting

OUTDOOR FLOODLIGHTING has made almost 13 acres of outdoor working area available for 'round-the-clock work at North American Aviation, Inc., Columbus, Ohio.

Floodlighting Outdoor Working Area

Outdoor floodlighting allows 24-hour utilization of 555,000 square feet of outdoor working area at the Columbus, Ohio, plant of North American Aviation, Inc. In addition to making almost 13 acres of work area available for night work, this installation has made possible unrestricted movement of aircraft at all hours and has reduced the night accident rate in the outdoor area. At North American, which has the lowest accident rate of any aircraft company in Ohio, night accidents are as infrequent as daytime accidents in the outdoor area.

The entire installation consists of 600 floodlights in 41 banks, mounted at a height of 48 feet and strategically located around the outdoor area. The floodlights, General Electric type L-69, range from 500 to 1500 watts. Throughout the area, the lamps provide an average constant light intensity of 5 footcandles. Under this general lighting, the outdoor working area is suitable for such work as: final preflight testing of engines, fuel flow, radar adjustment, compass alignment and painting.

The lighting result afforded by this floodlighting installation is closely related to the number of lamps in each bank, lamp wattages, mounting height, spacing of banks and the aiming of the floodlights. Uniform horizontal light and vertical spill were design objectives.

Functional Lighting In Hospital Rooms

Over 300 units of an artistically-designed direct-indirect incandescent wall fixture are now in service in the new Meadowbrook Hospital, Meadowbrook, L. I., N. Y. The fixtures, designed and manufactured by Gruber Lighting, Brooklyn, N. Y., provide indirect lighting for general room illumination and a lens-focused direct component for local bed lighting.

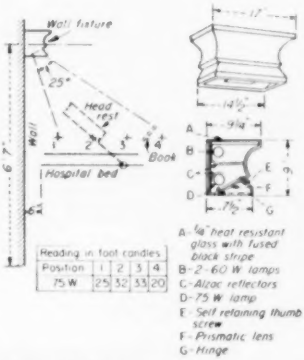
Each of the fixtures is wall mounted over a bed in either the wards, semi-private rooms or private rooms. The units are used throughout the hospital; and, due to dual light output, no other room illumination is necessary. Both the indirect general light output and the direct lighting are independently controlled.

The units are ruggedly constructed for continuous duty, and the design details facilitate easy cleaning and maintenance. The housing is of cast aluminum in an urn motif, with one flat vertical surface for mounting on the wall. The upper compartment of the fixture, for indirect lighting, contains two 60-watt incandescent lamps and an asymmetrical alzak reflector, with a dust-sealing ¼-inch Herculite tempered glass top. The lower compartment, for direct lighting, contains one 75-watt incandescent lamp, a symmetrical alzak reflector, and is shielded by a prismatic lens held in a hinged door at an angle of 55°. The door is locked by a self-retaining screw.

The dual light throw affords adequate lighting intensity with a high degree of visual comfort. The indirect component has a 75° light spread; the direct component, a 25° spread. The intensity of the direct light is 33 footcandles on a bed-patient's chest and is directed from behind, eliminating any direct glare. Manual control is provided for both of the light outputs.

As shown in the sketch below, the lens-focused direct component affords a range of footcandle intensities, from 20 to 33, for reading, writing and doctor's examination.

DIRECT-INDIRECT FIXTURE in the Meadowbrook Hospital provides diffuse upward component for general lighting and concentrated direct throw for local lighting on hospital bed.

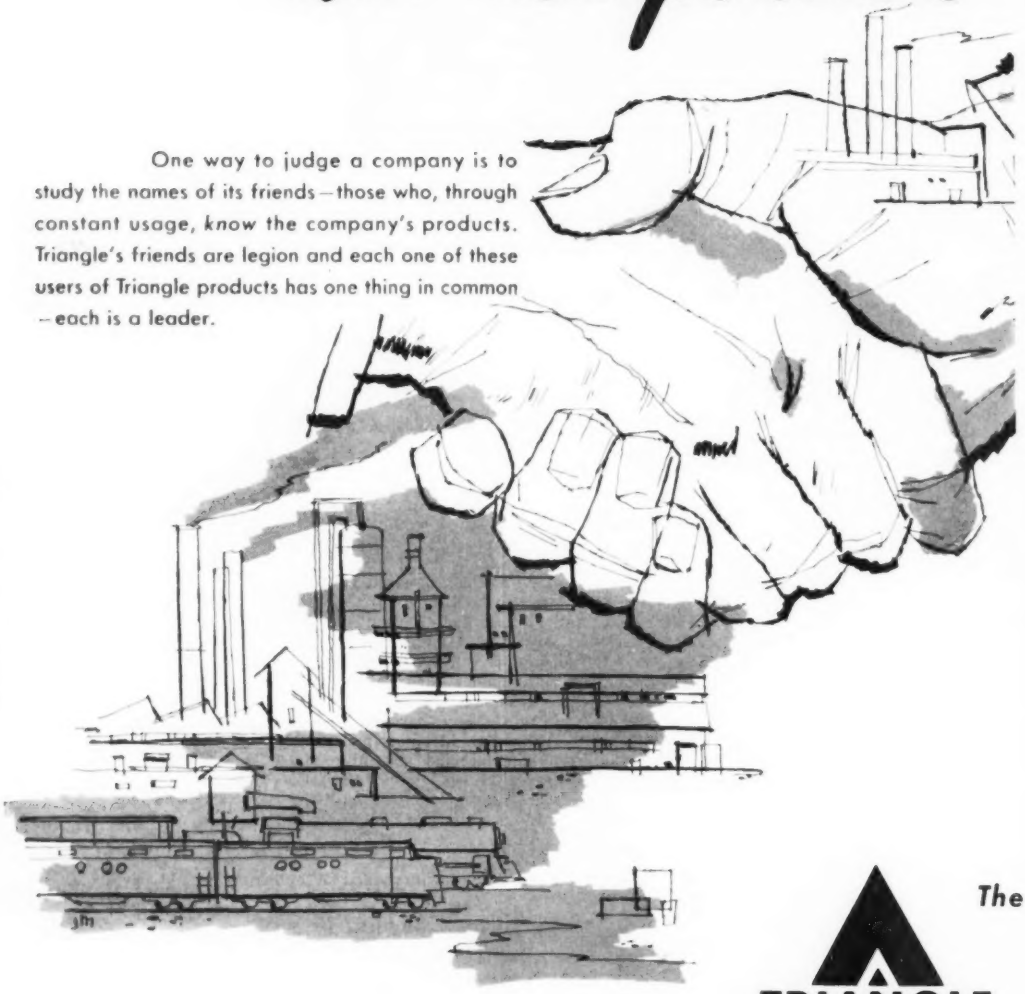


Reading in foot candles				
Position	1	2	3	4
75 W	25	32	33	20

SCHEMATIC VIEWS of the dual purpose hospital lighting unit and its location over the bed, showing mounting position and specifications.

A manufacturer is the companies

One way to judge a company is to study the names of its friends—those who, through constant usage, *know* the company's products. Triangle's friends are legion and each one of these users of Triangle products has one thing in common—each is a leader.

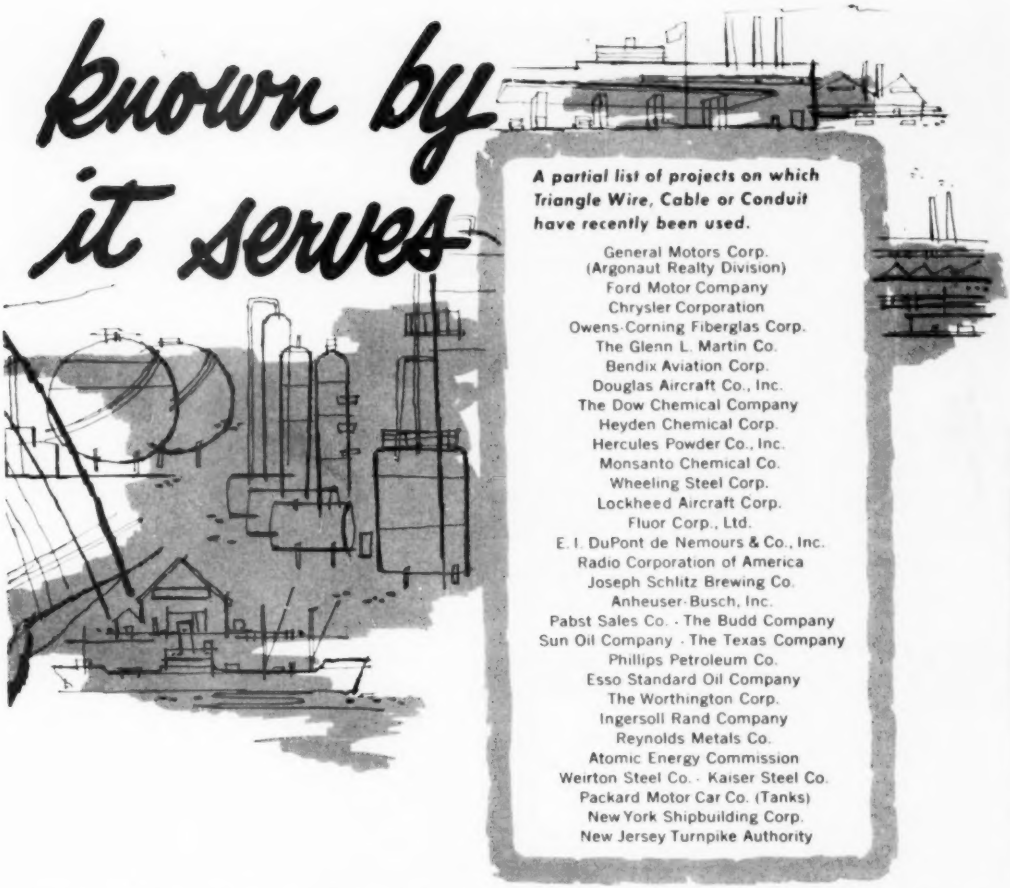


The

TRIANGLE

IT *MUST* BE RIGHT

known by it serves

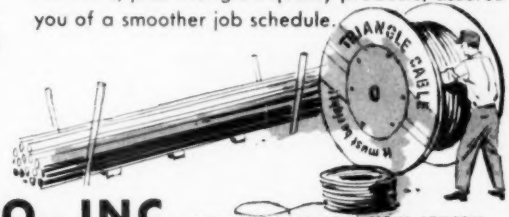


A partial list of projects on which Triangle Wire, Cable or Conduit have recently been used.

General Motors Corp.
(Argonaut Realty Division)
Ford Motor Company
Chrysler Corporation
Owens-Corning Fiberglas Corp.
The Glenn L. Martin Co.
Bendix Aviation Corp.
Douglas Aircraft Co., Inc.
The Dow Chemical Company
Heyden Chemical Corp.
Hercules Powder Co., Inc.
Monsanto Chemical Co.
Wheeling Steel Corp.
Lockheed Aircraft Corp.
Fluor Corp., Ltd.
E. I. DuPont de Nemours & Co., Inc.
Radio Corporation of America
Joseph Schlitz Brewing Co.
Anheuser-Busch, Inc.
Pabst Sales Co. · The Budd Company
Sun Oil Company · The Texas Company
Phillips Petroleum Co.
Esso Standard Oil Company
The Worthington Corp.
Ingersoll Rand Company
Reynolds Metals Co.
Atomic Energy Commission
Weirton Steel Co. · Kaiser Steel Co.
Packard Motor Car Co. (Tanks)
New York Shipbuilding Corp.
New Jersey Turnpike Authority

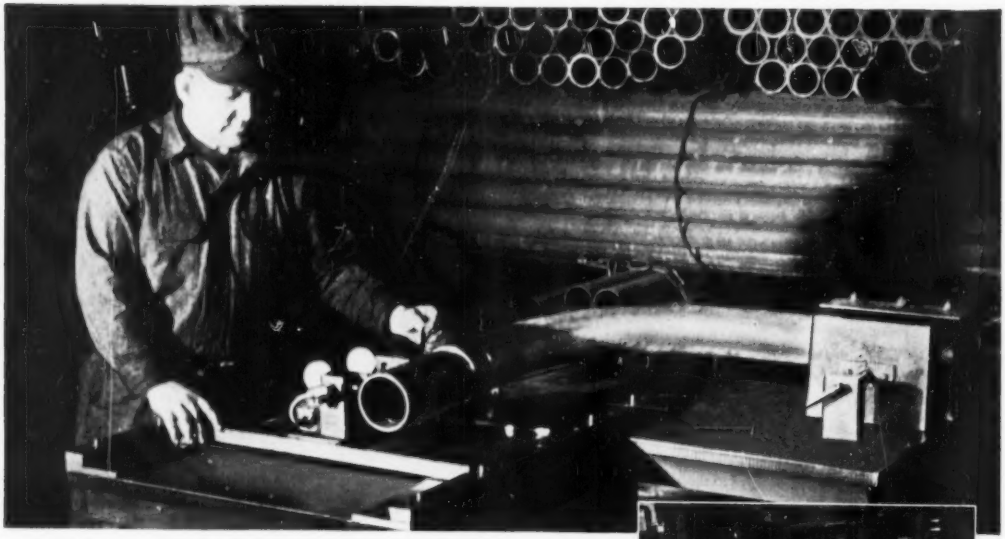
Why is it that month after month, year after year, Triangle is specified on projects for America's leading industrial firms? Industry takes to Triangle products because Triangle gives industry what it wants. Triangle's highly engineered wire, cable and conduit is top quality. The Company's service—through an efficient nation-wide network of recognized electrical distributors, district offices and warehouses, is fast, reliable and helpful. No matter who you are—contractor, maintenance man, superintendent, vice-president, electrician, electrical engineer, contact the nearest Triangle Distributor. Your requirements will be given meticulous attention. This, plus Triangle's quality products, assures you of a smoother job schedule.

Trade Mark of TOP Quality



CONDUIT & CABLE CO., INC. NEW BRUNSWICK, NEW JERSEY

"Glazon" Building Wire • "Glazon" Non-Metallic Sheathed Cable • Control Wire • Armored Cable • Service Entrance, Service Drop Cables • Varnished Cambric, Braided or Leaded • Trioprene Trench, Power & Parkway Cables • Bare Wire • Rigid Conduit, Hot-Dipped Galvanized & Black Enameled • Electric Metallic Thin Wall Conduit • Flexible Steel Conduit.



G-E quality control inspectors put conduit elbows through this angle tester. Elbows must test within 25/100 of a degree to be acceptable for delivery to your electrical wholesaler. Engineering care like this makes your job easier in the field.

G-E "WHITE" HAS TO MEASURE UP ON TEST AND ON THE JOB

Precision methods in the manufacturing and testing of rigid conduit help make G-E "White" the conduit that's built for easy installation, *engineered* for best performance.

For instance, an elbow that's as much as one degree off a true right angle can give you real trouble on the job—can actually throw a conduit run 21 inches out of line in every 100 feet. To help you avoid this kind of trouble, G-E quality control keeps the angle of every G-E elbow within 25/100 of a degree.

Because of this test and many others like it—exhaustive tests on zinc finish, tests for uniformity of weight, tests on the quality of steel—you can rely on G-E "White" for uniformity time after time. Begin now to standardize on G-E "White," and see what a difference it makes.

GET THE NEW RACEWAY CALCULATOR

New circular slide rule enables you to determine at a glance proper raceway sizes and boxes for use with specified wire sizes and number of conductors. Ask your G-E Construction Materials distributor for the new raceway calculator. Section C7-1218, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

You can put your confidence in—

GENERAL ELECTRIC

Your General Electric Construction Materials distributor can tell you about the uniformity of G-E "White" rigid conduit. He sees it every day in the week, knows it's engineered for performance.

You'll have fewer installation problems when you standardize on G-E "White" rigid conduit. Extra attention to quality at the factory means extra installation speed to the man on the job.

WHITE RIGID CONDUIT
engineered for performance

NEW PRODUCTS
CATALOGS, BULLETINS
ADVERTISEMENTS

WITH THIS POSTCARD

For further information on new products, trade literature and advertising appearing in this issue—

After the words "Item Number"—Just insert the numbers of any items appearing on the pages under PRODUCT NEWS, PRODUCT BRIEFS and CATALOGS, BULLETINS AND ENGINEERING DATA. Use the boxes provided.

After the words "Advertisement on Page"—Insert in the boxes the page numbers of any advertisements about which you want to know more. Where more than one advertisement appears on a page, include the manufacturers initials.

Please send me without obligation, further information about the following:

Item Number ☐☐☐☐☐☐☐☐

(Product News, Product Briefs, Catalogs and Bulletins)

Advertisement on Page ☐☐☐☐

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Do you have a problem in wiring layout, motor control, lighting methods, code interpretation? For sound technical advice

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Do you want advice on cost analysis, estimating and billing procedures, market conditions, or government regulations?

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Do you want to read more articles on some subject? Want names or addresses of any manufacturers? Do you have a gripe?

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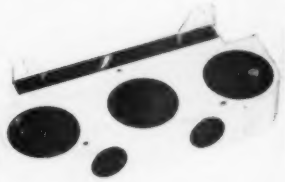
Product News



Lampholder (1)

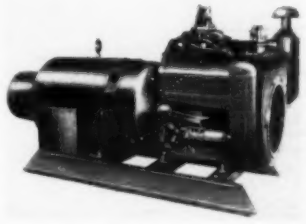
A complete line of turret-type lampholders for single pin and bi-pin fluorescent lamps in two and three lamp combinations. Five styles of single pin and three models of bi-pin holders are available. Principal features of bi-pin lampholders are: a full-circle cuff with four guide tracks to hold the spring contact. Two ear-type contacts, one on each side of lamp. Coil springs used directly in line with axis of lamp. Features of single pin lampholders include: at the high voltage end, a coiled spring paralleling the axis of the lamp and a spread-type leaf spring contact permits the plunger to press firmly against the lamp end cap and yet maintain solid contact with lamp pin. This eliminates arcing and resistance due to vibration. At the low voltage end, contact strips are eyeletted to the back plate and held in position by plate and plastic housing. Lead wires are color coded to match usual ballast lead wires.

Sylvania Electric Products, 1740 Broadway, New York, N. Y.

Flood Lamp (2)

A new 300-watt PAR-56 flood lamp of the all-glass sealed-beam type. Described as a "precision" lamp, its smooth, medium-spread beam is designed on the principle of the automobile headlamp. Prisms in the 7-inch lens cause a sharp cutoff of the beam, reducing "spill" light to a minimum. For outdoor lighting of service stations, sports areas, parking lots, building floodlighting and protective lighting. Also for interior applications such as show windows, displays, stages and exhibits. When used outdoors, a housing should be used to protect the bulb from rain or snow. The new light source has a base of the mogul end prong type. Designed for use in any burning position.

General Electric Company, Nela Park, Cleveland 12, Ohio



Stand-by Plant (3)

A new electric generating plant, engineered primarily for emergency standby service. It has a 10 kw capacity suiting it for a wide range of applications, hospitals, theaters, commercial buildings, industrial plants, construction projects, estates, etc. It is available with electric starting or can be supplied with controls which automatically start the plant the instant regular power fails. A feature is its four cylinder air cooled gasoline engine. It can be furnished for single phase or three phase service.

Universal Motor Co., 404 Universal Drive, Oshkosh, Wis.

UHF Transmission Line (4)

A new "all weather" UHF transmission line of unique construction has been developed for the benefit of the entire television industry. Known as ATV-270, the line serves as lead-in from roof-top to receiver. Design characteristics include: high-strength copperweld conductor surrounded by polyethylene spiral thread which acts as centering medium, allowing conductor to float within its individual polyethylene tube. Because dimensioning and spacing of conductors is all-important, the polyethylene tube is carefully and accurately extruded over Copperweld conductors and polyethylene spiral centering thread. Inner construction of outer jacket allows the twin tubes to "float in air". Brown polyethylene jacket assures better protection against weather, greater resistance to abrasion.

Anaconda Wire & Cable Co., 25 Broadway, New York 4, N. Y.

Switch (5)

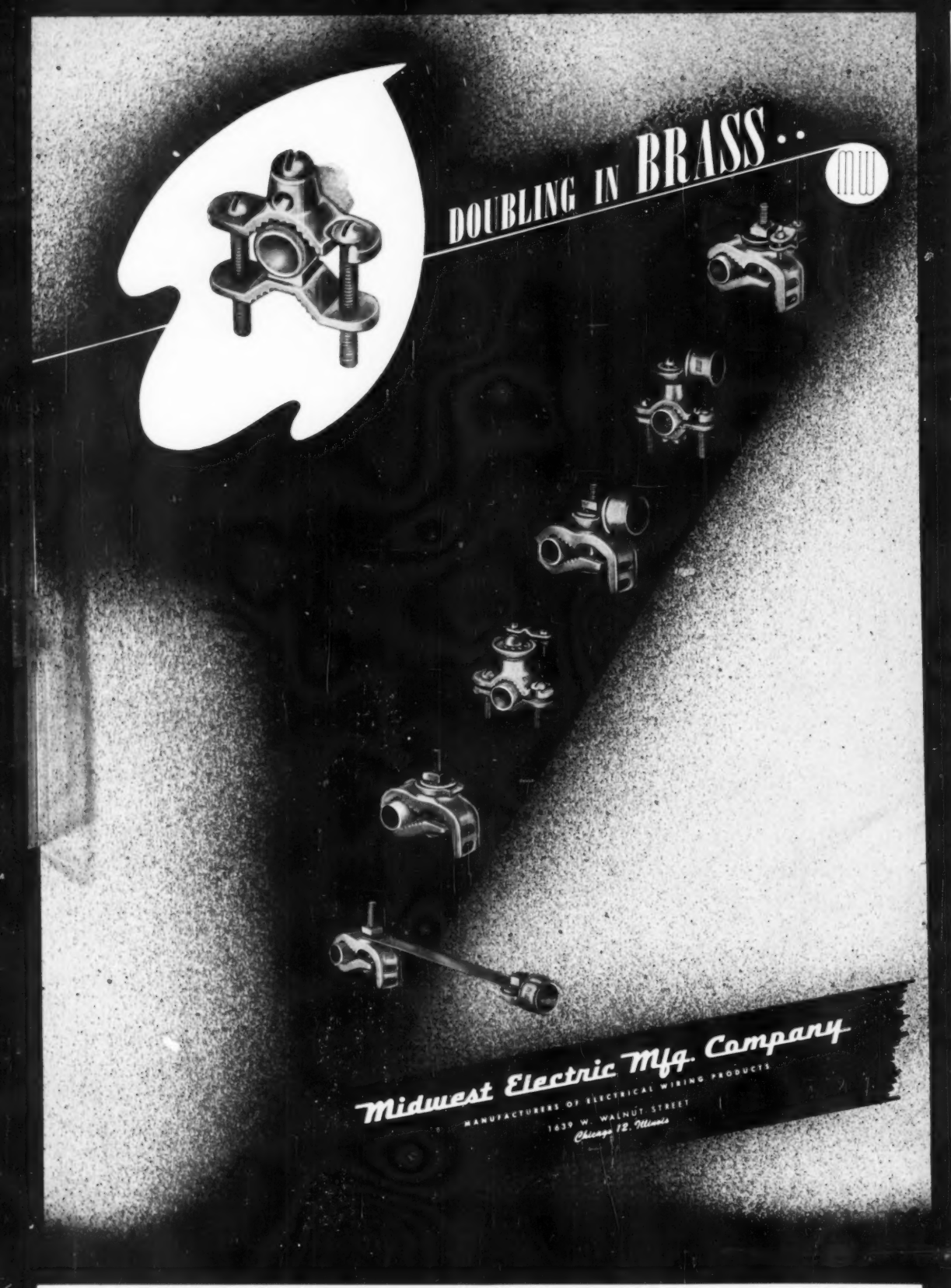
The Feller feather-touch switch responds easily to the pressure of elbow, arm, or any other part of the body—an advantage when you are carrying trays or other objects. The lightning-fast response is made possible by a new kind of precision workmanship. Cover plate and switch segments of the new switch are made from ivory plastic that's easy to clean, and it is crack- and shatter-proof. Switch is used with 12 amps, 110 volts. It contains sterling silver contacts. Switch is silent, making it ideal for schools, libraries, and hospitals, as well as homes and offices.

H. J. Theiler Corp., Whitinsville, Mass.

Transformers (6)

Three sizes, 30 va, 50 va, and 150 va, have been added to this line of control circuit transformers. A feature is better voltage regulation in low power factor circuits when momentary overload caused by high inrush current is encountered. Convenient, firmly anchored screw type terminals eliminate the need for terminal boards. Coil leads are soldered to terminals and taped to coil in winding operation. A terminal indicating nameplate is permanently attached to each transformer. Transformers are compact and especially suited for control panels where space is at a premium.

Hevi Duty Electric Company, 4212 W. Highland Blvd., Milwaukee 1, Wis.


DOUBLING IN BRASS..
Midwest Electric Mfg. Company
MANUFACTURERS OF ELECTRICAL WIRING PRODUCTS
1639 W. WALNUT STREET
Chicago 12, Illinois

Luminaire (7)

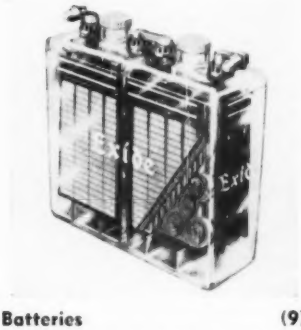
A shallow surface luminaire, type SC, 3¾ inches deep, is ideal for low ceiling areas. It may be mounted in rows or individually. Available in 4, 6, or 8 foot lengths and two and four lamp widths, the unit can be used with a variety of slimline and standard fluorescent lamps. It has translucent side panels. Hinged down louvers provide 35° shielding both crosswise and endwise. Unit employs new lead-lag ballast.

Westinghouse Electric Corp., Pittsburgh 30, Pa.

Insulating Material (8)

Vinglas insulation is a new Natvar Class B composite insulation consisting of a layer of varnish saturated asbestos paper sandwiched and securely bonded between two layers of varnished open-weave Fiberglas. It was developed for use in heavy duty equipment subject to abuse and overloads in normal service. It is tough and flexible. It does not flake, and conforms to irregular surfaces without application of heat. Available in two standard thicknesses: .025-.027-in., and .050-.044-in.

Natvar Corporation, Woodbridge, N. J.



Batteries (9)

A new series of Exide-Manchex batteries in transparent plastic containers. Known as Type CME, they are available in both two-cell and three-cell units. In these new units the weight per ampere-hour output has been reduced and also the over-all size of the units has been decreased. Transparent containers and covers are molded from clear, heat-resistant polystyrene. Permanent seal between containers and covers eliminates leakage of electrolyte. Heart of the CME is the manchester type Plante positive plate. In this plate the grid is an alloy, which resists the "forming" action of the electric current during charge and discharge. The active material in the positive plate is lead peroxide. Double insulation between positive and negative plates is provided by use of microporous rubber separators and slotted plastic sheets. Two-cell units are available in end-to-end and side-to-side assemblies, while three-cell units are furnished only in side-to-side assembly. Both have three capacities ranging from 8 to 24 ampere-hours at the 8-hour rate.

Electric Storage Battery Company, Allegheny Ave. at 19th St., Philadelphia 32, Pa.

Electric Heating (10)

Circle-Air convection heating system is a low cost type of convection electric heating with built-in thermostat in each unit. Approved by Underwriters Laboratories. Encased in grey metal cabinets, installations can be recessed within or placed against wall. Temperature in each room is controlled by adjusting automatic thermostat built into each unit. It is for use in homes, plants, stores, and as supplementary heating for basement, attic or wherever deficiencies exist. It employs a "fin" type heating element. Btu ratings from 2400 to 9600 watts: 5 sizes are available from 700 to 2800 watts, either with or without built-in Robertshaw thermostat.

Paley Manufacturing Co., 244 Herkimer St., Brooklyn 16, N. Y.

Limit Switch (11)

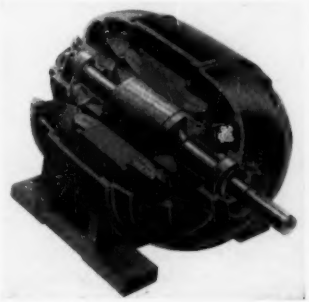
The "du.op" limit switch is now available with four new types of actuators. Standard type DU-S features long life; vibration-resistant; capability for fast switching action; minimum of bounce. The four new actuators are as follows: type DU-O is operated by a heavy duty ½-in. diameter nylon plunger; Type DU-L is a sensitive leaf actuator, and may be set to any of three leverage positions; Type DU-B may be actuated from the side or at any lesser angle by means of a ball serving as actuator; Type DU-E provides for plunger over-travel of up to .093 inch. Switch is rated at 20 amperes, 125 volts ac.

General Control Company, Boston 34, Mass.

Louvre Diffuser (12)

A new plastic louvre diffuser called GrateLite, for fluorescent fixtures and tubes. Diffusion results from the ⅜ inch cubical facets which give 45° by 45° lengthwise and crosswise lamp shielding. These small open facets form a modern, functional design in keeping with the architectural trends of today. It is molded of Lustrex styrene. With liquid detergents, GrateLite is cleaned quickly. The surface is de-staticized. Furnished in sizes up to 4 ft. long to fit fixtures of specified Guth design.

Edwin F. Guth Company, 2615 Washington Avenue, St. Louis 3, Mo.



Textile Motor (13)

A new screenless open textile motor, specially designed for positive lint expulsion. A simplified ventilation system provides both effective cooling and positive lint expulsion. Lint ladened air enters both endshields through large intake openings and is discharged through openings located farther out in the same endshields. Cooling fans, shaped to shed lint, force air and lint over end windings and smooth inside surfaces and out. Coil end-turns are filled with a special compound which provides a smooth finish and helps prevent accumulation of lint. Cast iron construction of frame and specially designed endshields protects the new motor against falling objects, dripping liquids, and corrosion. Rigid construction also prevents motor from twisting out of line when it is bolted down. Offered first in special ratings for "Soft-Start" textile applications, standard ratings of 2-15 hp at 1800 rpm, 1½-10 hp at 1200 rpm, and 2-7½ rpm will become available later.

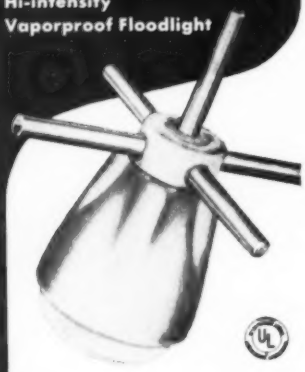
General Electric Company, Schenectady 5, N. Y.

Rab

LIGHTS THE WAY WITH...

VR300X

The *NEW* Hi-intensity Vaporproof Floodlight



Wherever hi-intensity vaporproof light is desired

YOU CAN'T BEAT THE VR300X!

If you need the ultimate in economical hi-intensity floodlighting, VR300X is the answer! This new Vaporproof fixture takes PAR 38 or R40 flood lamps, providing hi-intensity light without porcelain enameled reflectors! There is no high initial cost. No periodic cleaning of reflectors with VR300X!

VR300X has a heat resisting screw type front lens (as shown below). The junction box may be hung pendant, or ceiling mounted as an X type fitting. Plugs are provided for the unused ½" IPS Threaded opening.

The VR300X is the ideal floodlight for factories, loading platforms, storage yards, docks or warehouses.

Only **$13.00** List

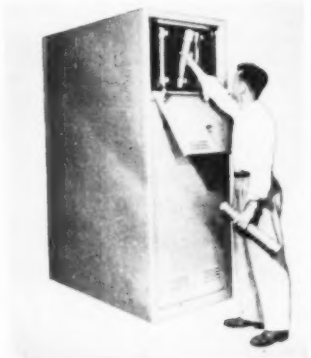
Rab

RAB ELECTRIC MFG. CO.
113 E. 138th St., New York 51, N. Y.

Fluorescent Fixture (14)

A 3-ring circline fluorescent fixture, Model 53-WE, is for commercial and industrial use. It features a 40-watt outer lamp, a 32-watt middle lamp and a 22-watt inner lamp. It operates without a starter. By using the large 40-watt lamp in combination with two smaller lamps, the fixture has a substantial increase in wattage, making it particularly suitable for offices, retail stores and institutions. It is also recommended for larger residential kitchens, recreation rooms and work rooms. It is available with either a white enamel or an all chrome body finish. A special lampholder design makes the fixture easy to clean and maintain. Dimensions: outer diameter 17 inches, height 5¼ inches.

International Lighting Inc., 6511 Easton Ave., St. Louis 14, Mo.



Fuse Handling Safety (15)

A new gang operated disconnect method for de-energizing the fuses on high voltage motor control. The new high voltage fuse compartment, called "Sa-Fuse," uses a movable panel on which current-limiting fuses are gang-mounted. Fuse panel has disconnecting blades behind the panel. When the fuse compartment door is opened, the fuse panel is automatically pulled to the front of the compartment, disconnecting the fuse panel from the line, and putting the fuse within easy reach. Mechanical and electrical interlocks prevent the fuses being disconnected when the switch is closed, and prevent closing motor switch with door open. Target indicators on door tell whether motor switch is opened or closed, and whether fuse panel is connected or disconnected. Door can be locked with fuse panel in either connected or disconnected position.

Electric Machinery Mfg. Co., Minneapolis, Minn.

Electric Heater (16)

The Chromalox UB series of blower-type electric unit heaters now includes a large 20 kw model. It is suitable for floor, wall or ceiling mounting. The UB heater consists of a heavy-gauge, sheet metal case with brown wrinkle finish, one or more Chromalox Koilfin strip elements sheathed with steel for safety, and a fractional hp motor blower. Adjustable aluminum louvers can be tilted to deflect the warm air stream up or down about 20°. A thermal cutout guards against overheating. Most UB heaters operate on either 230 or 460 volts single or three phase. Overall dimensions of the 20 kw size are 17 by 21 by 21 inches.

Edwin L. Wiegand Co., 7637 Thomas Blvd., Pittsburgh 8, Pa.

Tester (17)

A new pocket-size Test-Glo tester for checking electric circuits, spark plugs, motors, fuses, and a variety of electrical equipment. Capacity includes voltages from 80 to 600, ac or dc. Safety features include: 24-inch lead wire between test prods, permitting wide span; 5-inch prod handles for deep probing; safety-rings on prods to prevent fingers contacting tips; 10,000 volt lead wire; high grade resistors between each prod and lead to limit voltage in the lead; neon lamp at front prod in line-of-vision; all parts sealed against moisture.

Ideal Industries, Inc., Park Avenue, Sycamore, Ill.

IT PUTS THE SQUEEZE ON MAINTENANCE COSTS!

WESTON MODEL 633
CLAMP VOLT-AMMETER

A-C Current—five full scale ranges of 1000/250/100/25/10 amperes, with range overlap for good readability. Measurements under 10 amperes readily obtained.

A-C Voltage—three self-contained ranges of 700/350/175 volts insure accurate readability, in the upper half of the scale. Instrument insulated for 750 volt service.

Isolated Voltage and Current—with circuits insulated from each other, instrument can be connected to both voltage and current sources at same time.

Convenient 6 position switch—easily operated with gloved hand, a flick of the thumb selects any of the 5 current ranges, or the Volts position.

Adjustable pointer stop—red stop facilitates measuring starting current of motors.

Here's the instrument that produces big savings by slicing hours off maintenance schedules . . . produces worth-while revenue by forestalling costly repairs and shutdowns. Being so quick and simple to use, scheduled maintenance measurements are made more accurately . . . and trouble-shooting is simple and sure. Built to WESTON standards of safety, accuracy and dependability. Also available for A-C Ampere measurement only. Order through your local representative, or write . . . WESTON Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey . . . *manufacturers of Weston and Tagliabue instruments.*

WESTON TAG

WESTON *Instruments*

9238

. . . TO INDICATE—RECORD—CONTROL

You can REDUCE equipment failure

● Use Electro Custom Processed Varnished Insulation to INCREASE LIFE EXPECTANCY and to *insure* the *safe, successful operation* of *electrical equipment.*

Selecting dependable insulation need not present any problem to design, insulation and maintenance engineers if they specify ELECTRO. Our method of processing produces varnished insulation with the ESSENTIAL SAFETY FACTORS.

You may buy with confidence when you buy these

ELECTRO

TECHNICAL PRODUCTS

- Silicone Varnished Fiberglas*
- Quin-Glas Hi-Temperature Insulation
- Varnished Fiberglas* Cloth
- Electro "300" Combination Slot Insulation
- Treated Asbestos Cloth & Paper
- Flexible Varnished Cambric Tape
- Varnished Condenser Paper
- Varnished Silk and Rayon
- Cable Wrapping Tapes

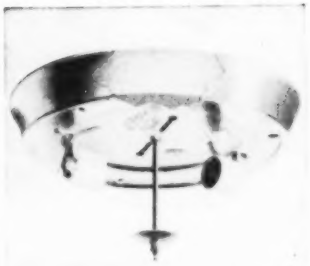
We invite you to use our Special Service facilities if you need varnished insulation to meet specific requirements. Write or phone Department E-1 for technical data and samples.

ELECTRO-TECHNICAL PRODUCTS

DIVISION OF SUN CHEMICAL CORPORATION

NUTLEY 10, NEW JERSEY

*T. M. Reg. U. S. Pat. Off. by Owens Corning Fiberglas Corp.



Lighting Fixture **(18)**

A new line of low wattage incandescent ceiling lighting fixtures that provide ventilation, insulation and heat dissipation. Offered in five series of polished chrome finish heavy gauge steel, with 6-inch to 16-inch opal, crystal or crystal cut glass globes. These pan type fixtures feature: A thick fibre glass insulating pad between fitter and ceiling, approved porcelain sockets "AE" wired and mounted on brackets; seating of globe on three embossed risers inside the flared flange of the fitter, allowing air to circulate freely into globe; keyhole slots for quick mounting to standard 3¼ or 4-inch outlet box; a switch knockout in each fitter. All fixtures carry UL and IBEW labels.

The Gleason Sales Co., 35-37 S. Desplaines St., Chicago 6, Ill.

Cable Reel **(19)**

Spring-O-Matic Powereel is an improved spring retractable reel for electric cable. It can be supplied for handling up to 150 feet of multiple conductor rubber cables in sizes up to No. 4 and for use with sound or communication cables. A feature is a specially designed rachet which functions in any of four positions. Reel may be mounted on the floor, ceiling or right or left wall. Rachet is optional and can be locked in or out of functioning position. It has an adjustable cable guide, which can be moved to any desired position on the circumference of the reel, permitting pull-down, pull-up or pull-out unwinding. With mounting bracket located under the reel and less than its width, it requires a minimum of mounting

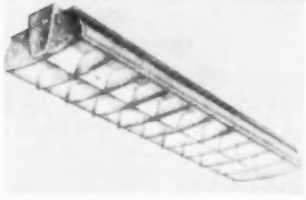
space. Unit is ball-bearing throughout. A gasket-sealed housing protects collector ring against dust and moisture.

Industrial Electrical Works, 1505 Chicago St, Omaha 2, Neb.

Power Failure Alarm (20)

The new low-cost power failure alarm operates without batteries and requires no extra wiring; can be plugged into receptacle or permanently connected to desired circuit. The instant current stops in circuit, a bell rings and a visual signal appears on the alarm which is designed for mounting on either horizontal or vertical surfaces. Unit operates off regular 110-115 volt ac; has metal case with outer surface red baked enamel; is 7½-in. in diameter, 2-in. thick, and weighs 2½ pounds. Comes complete with cord. Designed primarily for use on circuits serving infrared brooders, milking machines, water pumps, stock tank heaters and electric fence controllers. Can be used on any circuit where power-failure alarm features are desired.

AFCO-Lite Corporation, 1234 North Paulina Street, Chicago 22, Illinois.



Fluorescent Fixture (21)

A new Federal two-light fluorescent fixture for use in schools, offices, stores and any locations that require optimum lighting at low cost. Available with either plastic or steel side reflectors and may be purchased for bi-pin lamps in a four-foot unit or a double-section eight-foot unit and for four- and eight-foot slimline. Installation may be surface or pendant, individually or in continuous rows. Louvers are released by a finger action and are suspended by a chain at a convenient level for re-lamping.

Smithcraft Lighting Division, Chelsea 50, Mass.

- Conductor doesn't have to be centered for accuracy, (toroidal wound transformer)
- Pocket-size, belt-mounting
- Covers 9 ranges
- Probe jaws completely insulated
- Test lead plug insulates itself when removed from meter
- No-rim window floods scale with light

only

AMPROBE

has these features!

AMPROBE "600"
0-15/30/60/150/300/600 amps A.C
0-150/300/600 volts A.C
$59.50 complete with cowhide case and voltage test leads.

AMPROBE "1200"
to 1200 amps A.C
$87.50 complete

AMPROBE "300"
to 300 amps A.C
$49.50 complete

Measures current instantly without interrupting service

PYRAMID INSTRUMENT CORP., LYNBROOK, N. Y.
(Export Div., 458 Broadway, N.Y.C.)

AMPROBE®

the only pocket-size snap-around volt-ammeter

WRITE TODAY:

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Send Bulletins describing

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Company _____
Address _____
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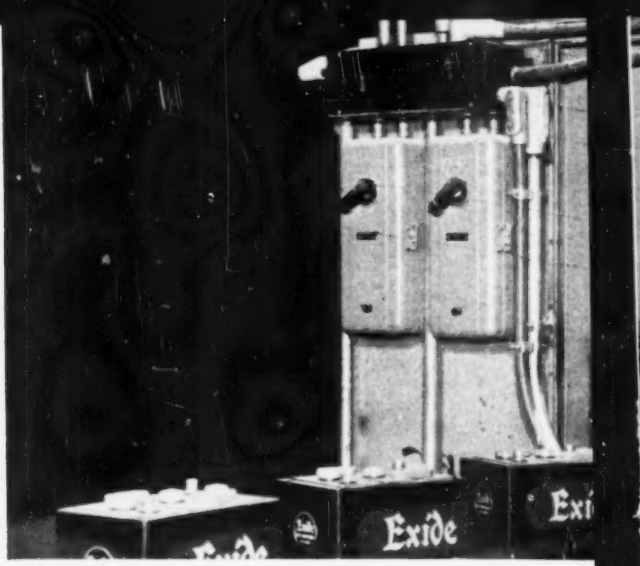


◀ **NICKEL PLATE ROAD** has been modernizing their shop at Brewster, Ohio. One example: on an existing milling machine, left, a new G-E motor and a G-E full-voltage, combination magnetic motor starter assure top production. Their maintenance men say, "This G-E starter takes plenty of abuse and is easy to maintain."

Three more leading

"G-E Magnetic

Nickel Plate Road, The Electric Storage Battery Co. and Electro-Lift, Inc. have joined the thousands of companies who use G-E magnetic motor starters to maintain top production.

They know that dependable G-E starters give longer-lasting protection against shutdowns. Exclusive G-E features assure millions of starts and stops—even under tough conditions, varying loads.

LOW MAINTENANCE

One big reason these companies chose G-E starters is low maintenance, year after year. The only tool needed is a screwdriver. Contacts are easy to inspect and remove—maybe interchanged without adding parts. Captive lockwashers, screws, and terminal clamps save time, make maintenance easier.

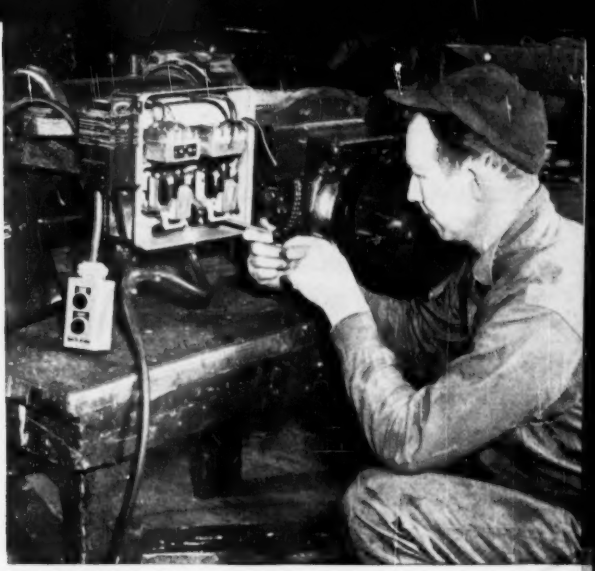
WIDEST VARIETY

General Electric manufactures the most complete line of motor starters. You have your choice of all NEMA sizes in general-purpose, watertight, dust-tight and explosion-proof enclosures. It's easy to add interlocks in G-E starters—change from normally-open to normally-closed—change coils.

FAST DELIVERY

You can get G-E starters right off the shelf by contacting your nearest G-E Apparatus Sales Office or authorized distributor. For more information send for bulletin GEA-5781. Address Section 730-40, General Electric Co., Schenectady 5, N. Y.

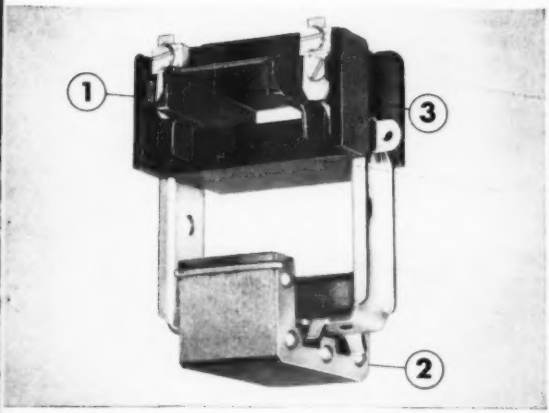
▲ **THE ELECTRIC STORAGE BATTERY CO.** of Philadelphia, Pa. makers of Exide Batteries, chose General Electric magnetic starters to protect production flow. They report no shutdowns due to starter failure. Above, two G-E fusible combination starters are used in key section of an Exide production line.



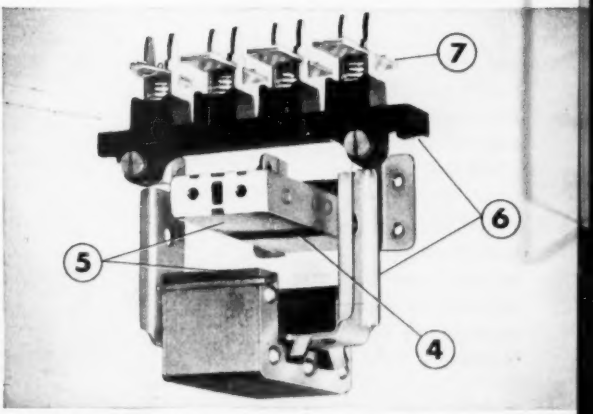
ELECTRO-LIFT, INC. of Bloomfield, N. J. makes motorized hoists which are subject to continual start-stop operation. They use G-E magnetic starters to assure unfailing operation to their customers, and to speed their own production. Ample wiring room and large pan-head screws, all in front, mean fast, easy installation.

industrial plants report:

Starters keep production up!"



LONG LIFE is built right into the heart of G-E starters: the tough G-E *stronghold* coil (1). Winding is sealed in solid, molded plastic; dust, oil, moisture sealed out. This coil cannot be damaged by a maintenance man's screwdriver. Movable magnet of silicon steel (2) moves in straight line in permanently lubricated guides (3).



DEPENDABILITY is further assured by strong, simple construction. Magnets cannot stick shut because G-E starters have a *permanent* air gap (4) in stationary magnet. Gap never wears out—it is independent of striking surfaces (5). Unit construction (6) means no bearing pins. Note block of fine silver on contact tips (7).

GENERAL ELECTRIC

TAILOR-MAKE YOUR OWN

CONDUIT OR PIPE BENDS

RIGHT ON THE JOB

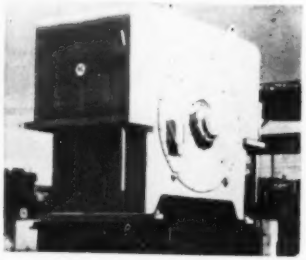
...simple, quick with the

GREENLEE HYDRAULIC BENDER

Yes, quickly make bends *exactly* as you want them, when you want them, where you want them. Compact, portable GREENLEE Hydraulic Pipe and Conduit Bender lets you do this in a jiffy. *One-man operated* to produce smooth, accurate bends in just a few minutes . . . in pipe up to 5", rigid and thin-wall conduit, tubing, bus-bars. Owners report timesavings up to 60% and more, elimination of cost for manufactured bends and fittings, and "clean", tailor-made installations every time. Get facts now on this time-saving tool that often pays for itself on first few jobs! Write for free Bender Booklet, Greenlee Tool Co., 1752 Columbia Avenue, Rockford, Illinois.

GREENLEE

Other GREENLEE timesaving tools for electrical work: Hand Benders; Joist Borers; Cable Pullers; Knockout Tools; Auger Bits and Drills.



Motor (22)

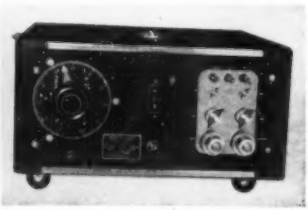
A new outdoor weather-protected motor designed to keep wind-driven heavy moisture out of its windings. Its intake velocity has been reduced to less than 600 feet per minute, so heavy rain particles cannot be drawn into motor. Air moves vertically upward through side intakes into an expanded air space. Rain gutters are provided on sides at air intakes, draining through pipes to the ground. Top of yoke is slanted slightly to keep water from accumulating in puddles on top. To prevent dust and dirt from entering the machine during periods of dry weather, air intakes are located at a considerable height above ground level. No special concrete foundation or base is required with this motor. Available in full range of ratings required for major auxiliary drives, including boiler feed pumps.

Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.

Insulation (23)

Irv O-Bestos, a new Class "B" insulation consisting of Mylar Polyester film bonded to Quinterra asbestos papers in duplex and triplex combinations. This new type of insulation not only has high tensile and tear strength, but exceptional dielectric strength as well. Suggested applications for this material might be as motor and dry-type transformer insulation, magnet wire insulation, coil and relay insulation, sheet insulation, or as primary cable insulation.

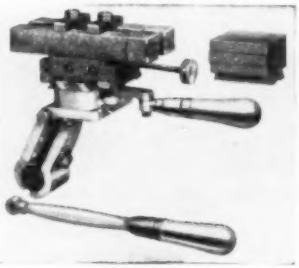
Irvington Varnish and Insulator Co., Irvington 11, N. J.



Test Unit (24)

A portable high current test unit designed primarily for use by electrical utilities and large industrials. The principal uses of Model 1005, include testing and calibrating oil circuit reclosers, CSP transformer breakers, sectionalizers, circuit breakers, motor overload relays, current transformers, fuse links, and overcurrent relays of all types. Unit may also be used for drying out damp electrical windings, and for making "heat runs" on wires, connectors, switches, and sockets. The output is adjustable in stepless increments from 0 to 1000 amperes in eight ranges. Each range is rated at .25 kva based on a four hour duty cycle. Terminal voltages are adjustable from 0 to 115% of following values: 200, 100, 75, 50, 25, 10, 5, and 2.5 volts.

Multi-Amp Corporation, Harrison, N. J.



Commstone Holder (25)

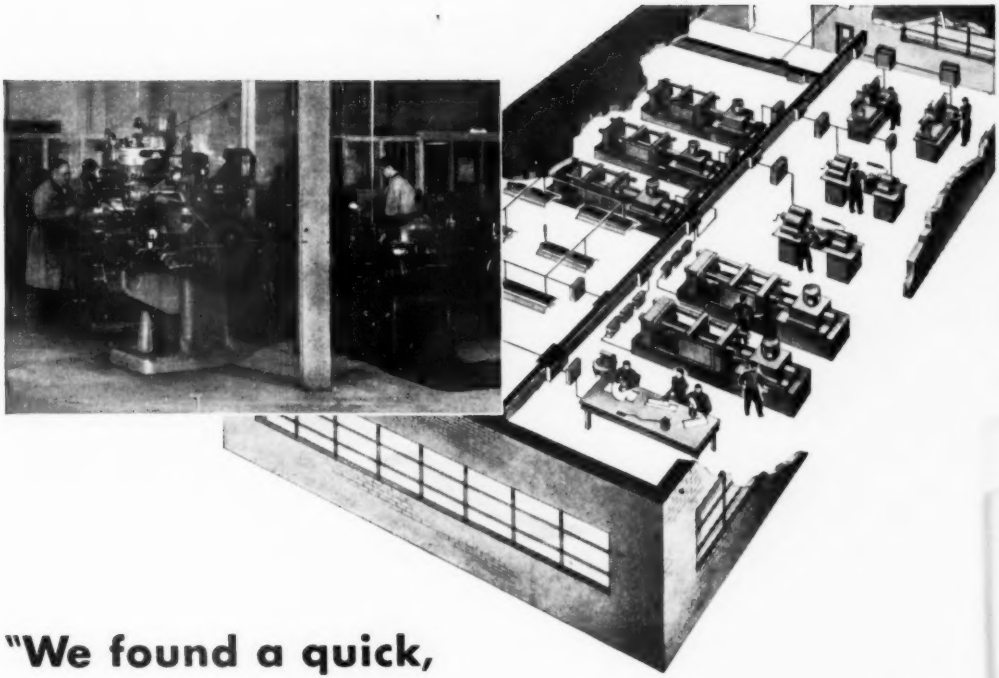
Type C commstone holder holds commstones rigid and true for concentric resurfacing commutators and slip rings while running at normal speeds in their own bearings. Features are: 3¼-in. wide; fits in close-quartered jobs. Flexible cross-feed handle can be deflected to one side in cramped quarters. Adjustable support, hinged at center, with insulating bushings for brush-arms ⅜-in. to 1-in. diameter. Equipped with either stoneholder or 2-in. box. These are interchangeable.

Martindale Electric Co., 1309 Hird Ave., Cleveland 7, Ohio

Transformer (26)

A completely enclosed, non-ventilated dry-type distribution transformer for service on secondary circuits rated 600 volts and below. Designated as type E, it supersedes the type AJR line of dry-type transformers. It utilizes Hipersil cores and class H silicone insulation and operates at 120° C rise. Both high- and low-voltage leads are brought to Micarta laminated plastic terminal boards at the bottom of the case. Since the temperature of the terminal compartment is less than 30° C, standard insulated cables can be used for wiring through conduit. Knockouts are located at the bottom of the case walls. In addition to the 3-, 5-, and 10-kva AJR sizes superseded, the type E will also be built in 15-, 25-, 37½ and 50-kva ratings. The three smaller sizes are designed for indoor or outdoor service and wall mounting. Ratings above 15 kva, also for both indoor and outdoor service, are designed for floor or platform mounting.

Westinghouse Electric Corp., Pittsburgh 30, Pa.



"We found a quick, low-cost answer to our load problem!"

"When we purchased our present plant, we had to find a quick, practical, economical way to step down the existing 440 voltage," says the manager of an eastern plastics factory.* "By installing 24 Westinghouse Dry-Type Transformers on the high-voltage line near our presses, we got the voltage transformation plus the good regulation we wanted. They've proved their reliability by sustaining frequent, heavy overloads for periods up to half an hour."

Whether your load problem involves additions to your production line, large-scale plant expansion, or complete plant conversion, like this manufacturer, Westinghouse Dry-Type Transformers carry these savings right down your line: *Lower Installation Costs* . . . their small size and light weight need only the simplest mounting. *Lower Operating Costs* . . . mounted close to the center of the load, they assure better power regulation. *Lower Power Costs* . . . they eliminate the losses resulting from long low-voltage runs. *Lower Maintenance Costs* . . . they require practically no maintenance. Available with or without built-in circuit breakers.

Get the complete story from your local Westinghouse representative. Or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh, Pennsylvania. J-70642

YOU CAN BE SURE...IF IT'S
Westinghouse
DRY-TYPE TRANSFORMERS

*Name on request

You can THREAD and CUT Conduit Faster with a QUIJADA CHIEF

No wrestling with stubborn chucks. No wrenches. Exclusive Automatic Chuck operates at the flip of a switch. Four jaws front and rear instantly grip, center and turn conduit or pipe. Reams while threading. Equipped with wheel-type cutter. Weighing only 160 lbs. the Chief is perfect for in the shop or on the job use.

Check these times against your present methods.

Pipe Size	½"	1"	1½"	2"
Chucking Time	None — Automatic Chuck			
Threading Time	11 sec.	14 sec.	15 sec.	18 sec.
Reaming Time	None—You Ream While You Thread			
Cutting Time	5 sec.	6 sec.	7 sec.	8 sec.

For Cutting Only — your Best Buy is a Portable E-Z CUTTER

Exclusive Power Driven Rollers revolve conduit or pipe for constant cutting. No slipping. Thousands of cuts per sharpening. Convenient foot switch frees operator's hands—speeds cutting! ⅛" to 2" range eliminates time lost in size changes. One lightweight E-Z Cutter handles all your cutting requirements anywhere.

CUTTING SPEED

Pipe	½" 2 sec.	1" 4 sec.	1½" 8 sec.	2" 10 sec.
Tubing	⅛" ½ sec.	1" 2 sec.	2" 4 sec.	3" 6 sec.

SEE YOUR JOBBER OR WRITE FOR NEW CATALOG EC-12

QUIJADA TOOL

DIVISION OF **GAINES-COLLINS** 5474 Alhambra Ave., Los Angeles 32, Calif.

Manufacturers of Automatic Threaders & Cutters for More than a Quarter Century.

Carry **WATER, GAS AIR LINES, CABLE** *at any angle to beams*

with

"EFFICIENCY" CONDUIT HANGER "TYPE F"

On open steel construction, Efficiency "Type F" Conduit Hangers are your best choice for carrying ½" to 2½" pipe and armored cable. Patented radiating ridges and 5-point gripping surface keep pipe and cables suspended dead center, permitting it to be carried securely at any angle to the beam. Write today for Catalog 38-A.

Efficiency ELECTRIC AND MANUFACTURING CO.

MANUFACTURERS OF EFFICIENCY ELECTRICAL DEVICES FOR CONDUIT, WIRE AND CABLE SUSPENSION

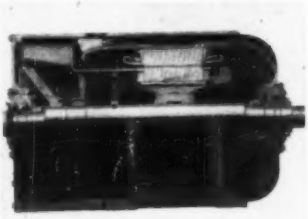
EAST PALESTINE, OHIO

EFFICIENCY" DEVICES FOR CONDUIT and CABLE SUSPENSION

Blower **(27)**

A high pressure blower that removes fumes, smoke, dust, sawdust and obnoxious odors. The all-aluminum, blower moves up to 450 cubic feet of air per minute. On standard unit, made with a 5½-inch inlet and 3½-inch outlet, power is supplied by an enclosed, 1/6 hp, Westinghouse, 115 volt, single phase ac, 3450 rpm motor. Larger sizes with different speeds and different current characteristics can be obtained.

Standard Electric Mfg. Co., Inc., West Berlin 12, N. J.



Induction Motor **(28)**

A new totally enclosed, fan-cooled, high slip induction motor, designed for use in acceleration of high-inertia loads such as punch presses, centrifuges, hoists, etc. It is designated as Type KRX. In the new motor, low-resistance rotor bars are extended on one end and pass through a rotating baffle plate. Beyond the baffle plate, the bars are brazed to strips of high-resistance metal, shaped to form a radial-blade fan. These fan blades, provide the higher rotor resistance necessary for high-slip characteristics. Reduced heating within the motor enclosure allows a normal air gap between rotor and stator to be maintained. Available in 30 to 150 hp at 900 and 1200 rpm, 5-8 and 8-13 percent slip. Voltage ratings are 220, 440 and 550.

General Electric Co., Schenectady 5, N. Y.

Varnish Remover **(29)**

A non-inflammable impregnating varnish remover that strips all types of impregnating varnish from baskets, jigs, equipment, etc. Known as Lonco, it is

designed for fast stripping at room temperature of all types of varnishes used in the electrical field to impregnate armatures, field coils, etc. The only equipment necessary is a covered steel tank large enough to accommodate the pieces to be stripped. Parts are normally stripped clean in ½ to 4 hours. Overnight immersion will remove heavy coats as much as 3 inches in thickness. It works equally well with air dried varnishes or varnishes baked at temperatures from 125° to 640° or over.

London Chemical Co., 325 W. 32d St., Chicago 16, Ill.

Suspension Device (30)

A new lightweight 3-lamp cluster suspension unit designed for use with reflector lamp assemblies as well as conventional luminaires. Designated AL-8700, this suspension device will support three luminaires weighing up to 10 pounds each. It is particularly suitable for application in industrial plants, aircraft hangars, foundries, gymnasiums, arenas, etc., because it provides for increased lighting capacity and efficiency without requiring installation of additional outlets. It features aluminum alloy construction throughout. Three ½-inch pipe-size tubes are used to support the fixtures. These tubes, threaded at fixture connection ends, are slip-fit and locked by means of set screws in side hubs spaced 120° apart on junction box.

The Thompson Electric Co., 1157 Power Ave., Cleveland 14, Ohio.

TV Antenna System (31)

A new master amplified TV antenna system is now available to owners of apartment buildings, hotels, institutions,

TRADE ARRO MARK

announces the NEW

ARROFLUTE

CARBIDE MASONRY DRILL

CARBOLOY CEMENTED CARBIDE TIPS

For All Masonry

Removes Dust Automatically

•

Drills Full Depth

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Faster Cutting

•

Longer Life

•

No Stalling

BRICK

CONCRETE

MARBLE

SLATE

TILE

Now, you can drill any type of masonry easier . . . brick, concrete, marble, slate, tile, and plaster. Arro's new improved Arroflute Masonry Drill with carboloy cemented carbide tips—drills faster, easier, cleaner and deeper than any other drill.

The New Arroflute Masonry Drill is designed to remove the dust as it drills. No packing—no stalling . . . Arroflute drills full depth without removing.

Ideal for . . . Expansion-bolt installation—sign hanging—insulation work — installing equipment — plumbing — anchoring partitions — wiring buildings — building maintenance — tile setting — antenna installation.

Write for Catalog #68 Describing Arro's Complete Line of Anchoring & Drilling Devices for Masonry.

ARRO EXPANSION BOLT CO. • MARION, OHIO

Sold through distributors only

KLEIN

Talk to any old-timer on the job and he'll tell you Klein equipment is his choice for comfort—for safety—for service. Look for the familiar Klein trade-mark on pliers, safety straps and belts, climbers, grips and wrenches. Klein has been serving the electrical industry "Since 1857."

ASK YOUR SUPPLIER

Foreign Distributor: International Standard Electric Corp., New York

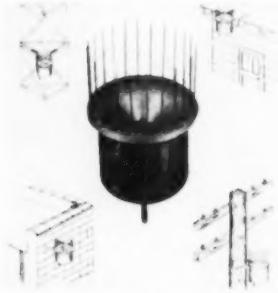
Write for your free copy of the Klein Pocket Tool Guide today!

"Since 1857"

Mathias Klein & Sons Established 1857 Chicago Ill. U.S.A.
3200 BELMONT AVE., CHICAGO 18, ILL.

and TV service organizations. It is an Amplified system, designed to produce peak reception on each channel in an area—on every TV set in the building, regardless of its location. There is no interference between sets; no cross-modulation between channels. By the use of one specially designed yagi type antenna for each channel, stronger directional signals are obtained. By amplifying each channel separately, weak signals are amplified in weak areas, and strong signals are balanced, so that all channels are received at the same level at the receiver. One amplifier is capable of servicing a large building with as many as 175 apartments. It is designed to operate at from 250 to 5,000 microvolts. Channel strips use four 6AG5s and a 6AQ5 or 6AN5 in the output stage.

Amplitel, Inc., 362 W. 57th Street, New York 19, N. Y.



Weather Sensing Equipment (32)

A new weather sensing unit known as the "Snow Detector", designed primarily for the deicing of microwave antennas. Wherever severe icing conditions and snowfall impair the operation of moving parts, an electronically controlled heater will solve the problem. Unit is especially useful for the automatic and efficient operation of sidewalk snow removal systems. The unit, 7¼ inches in diameter, detects precipitation when the ambient temperature drops below 37° (the normal borderline temperature for snow). An integral heater melts the snow and ice collected in the "bowl". Vertical rods around the edge of the unit prevent birds from nesting in the detector. Fully automatic, the detector will turn on heating elements whenever icing conditions exist. Up to 30 amperes at 117 volts ac can be switched without external relays. Heaters will then remain on until icing hazard is past, being automatically turned off by the detector.

Motorola, Inc., 4545 W. Augusta Blvd., Chicago 51, Ill.

Lampholder (33)

A new pin-type lampholder with weatherproof socket. It permits the use of various types and sizes of wires including No. 10 and eliminates the need for stripping, splicing, soldering or taping. Pinpoint contact is positive. Both

wire and lampholders may be used over and over again. All brass contacts are used. Wire grooves in socket are ribbed to center the wire regardless of type or size. A threaded metal insert in the tap prevents breakage and stripping when screwed down. Contact pins are sharp-pointed and heavy-duty type. Large scallop grips are on the edge of the cap and a detachable galvanized wire hook is supplied. A wiring device for carnivals, conventions, parties, picnics, decorative displays and celebration lighting.

John I. Paulding, Inc., New Bedford, Mass.

Lamp Starter (34)

A new automatic reset fluorescent lamp starter, the FS6-NA is a two-pin starter for use with 85, 90 and 100 watt lamps. It automatically cuts out a blinking and flashing lamp which has reached the end of life and automatically resets the cutout to provide normal operation when the new lamp is installed. It also protects ballasts from overheating due to continuing starting attempts. Starter consists of a glow-switch (Globottle) and heater to operate a bimetallic element which automatically opens the flow-switch circuit after the starter has attempted unsuccessfully to start a worn-out lamp.

Sylvania Electric Products, Inc., 1740 Broadway, New York, N. Y.

Motor (35)

A new spinning-frame motor, especially designed for the new Saco-Lowell SG-1, "Gwaltney" spinning frame. Motor is a totally enclosed fan-cooled, self-cleaning model designed to save floor space by fitting under the spinning frame. Stator frame, endshields, and fan guard have smooth surfaces to prevent lint accumula-

Save time and labor ...increase output

WITH AB-I CIRCUIT BREAKERS

Westinghouse AB-I Circuit Breakers reduce down time after a circuit fault . . . because they can be "Reset" in seconds after the fault is cleared. As a result, you save time and labor; production keeps rolling.

In vivid contrast, other types of circuit protective devices require element replacements. This takes valuable time for which you pay.

Unnecessary service interruptions are out, too, with AB-I Breakers. Inverse time-delay trip mechanism carries harmless, peak overloads without interrupting the circuit. Yet, on shorts or dangerous overloads all poles open instantly. Tamper-proof calibration stays exact.

Self-indicating AB-I Breaker handle mechanism shows breaker setting without opening cover. Handle mechanism meshes with breaker handle regardless of breaker setting, prevents damage if cover is slammed shut. Handle may be padlocked to prevent tampering, but on a fault, breaker is trip-free. It cannot be held or locked "On".

For facts, call your Westinghouse Representative or write for B-5456, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-30091

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Westinghouse
AB-I Circuit Breakers
THE COMPLETE LINE

"Of course, circuit breakers save money"

Water- and Dust-Tight | Explosion-Proof | Oil-Immersed—Explosion-Proof

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when it is so easy to install

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Telephone Ringing

RELAY SETS and accessory

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These Relay sets have already been installed in many leading communities for operation of Civilian Defense Alarms.

The SIGNAL Relay Set can be installed quickly and easily. It is designed to operate on standard telephone ringing current of 15 milliamperes at 90 volts, 20 cycles.

The Telephone Ringing Relay Set has been proved in service and is of the same high quality which characterizes all relays, devices, and control systems built by the Signal Engineering and Mfg. Co.

Sales Representatives in Principal Cities.

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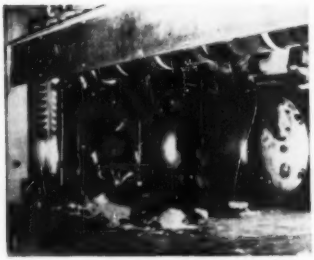
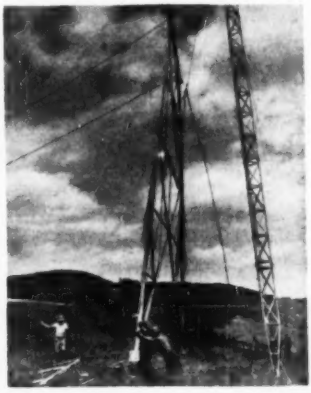


tion. An external cooling fan made of non-sparking Textolite forces air over outside of motor frame and down length of spinning frame. Electrical characteristics provide maximum, almost constant efficiency for varying spinning loads from 50% to 115% of the motor's full load rating. Motor is equipped with a Stearns electric brake, also a thermostatic relay which automatically stops motor in event of an abnormal rise in temperature. Can also be supplied in a water-cooled model. Available ratings for both models are 15 and 20 hp at 1800 rpm. Other ratings are available on special order.

General Electric Co., Schenectady 5, N. Y.



Sectional Pole (36)

This gin pole is available in two lengths; 48-ft is standard, but an additional section of 12-ft. can be secured to make the pole 60-ft, if desired. With a direct load lifting capacity of 8,000 pounds, and a weight of 600 pounds, the pole itself can be disassembled and handled by two men. The four sections can be loaded on a pick-up truck to be carried to the next tower site.

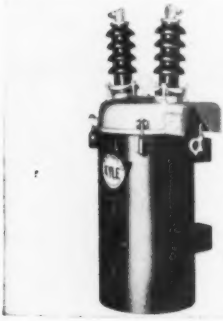
Washington Aluminum Company, Knecht Ave. & Pennsylvania R. R., Baltimore 29, Md.

Capacitor Equipment (37)

New 300-kvar, open-type, automatically-switched capacitor equipment for 15 kv ungrounded wye or delta systems. A basic impulse level of 95 kv permits application on 15-kv systems. The 25-kvar

capacitors are mounted on pedestal insulators to provide increased insulation. For protecting the equipment from voltage surges, 15-kv lightning arresters may be used. Equipment is factory assembled and tested. It is also supplied without switches for use as a fixed capacitor equipment.

General Electric Company, Schenectady 5, N. Y.



Recloser **(38)**

Type "E" and Type "L" reclosers have recently been rerated. A 200 ampere rating has been added to Type "L" and has increased the interrupting rating 3000 to 4000 amperes at 14.4 kv line-to-line nominal voltage. The higher nominal load ratings involve a new coil and some increase in the capacity of certain current carrying parts. The interrupting ratings of Type "E" have been extended to 1,750 amperes at 23 kv and up to 2500 amperes at 14.4 kv, nominal line-to-line voltage. Type "E" is now available with a choice of 8 coil ratings, 3 time-current curves and 7 tripping sequences. Coils and sequences are easily changed in the field.

Line Material Company, 700 W. Michigan St., Milwaukee 1, Wis.

Lighting Fixture **(39)**

A new hospital lighting fixture, No. T-580, offers direct and indirect light throw for general and/or local lighting over hospital beds. This wall mounted unit uses two 60-watt incandescent lamps in its upper section for general lighting

"Let me tell you why

My Men Want BLACKHAWK Benders..."

PROOF that today's No. 1 Bender Line saves time, saves money!

"MY MEN LOVE THAT REMOTE CONTROL! With the hydraulic pump and ram separated by a flexible hose, a man can move around — 'jockey' the pipe with one hand — sight along it if necessary . . . without stopping the pumping."

"IT'S JUST PLAIN HANDIER and a Blackhawk costs me nothing extra. Works in any position—on its side or upright — on table or floor — on existing runs. So naturally, I give my men exactly what they want to make their job easier and cut my own costs on both rigid and thin-wall conduit."

AND IF YOU WANT TO MOTORIZE your hydraulic equipment, the inexpensive P-182 portable electric pump provides fingertip control, cuts manual labor, triples output. Especially effective for repetitive bends or heavy pipe. Remember, too—Blackhawk hydraulic units can be detached to lift machinery, pull pulleys or for other allied jobs.

WRITE FOR THESE NEW BOOKS — 50B and P50! They describe the remarkable, low-cost "Porto-Power" hydraulic units — the popular Benders S30A, S36 and S34 — also the amazing new hydraulic Knock-out Punches that are 60% faster.

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HYDRAULIC *Porto-Power* EQUIPMENT

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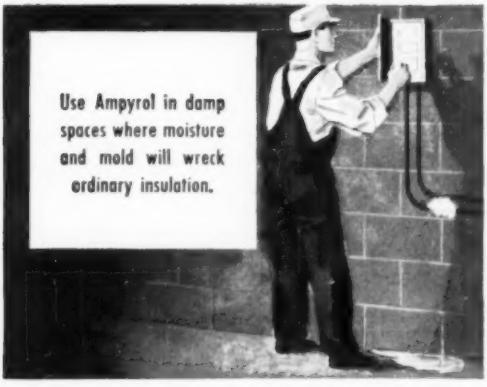

A STANDARD Cable for every

- paper & varnished cambric cables
- asbestos cords and cables
- aerial, underground & submarine cables
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USS
AMERICAN ELECTRICAL WIRE AND CABLE
UNITED STATES STEEL

U·S·S AMERICAN ELECTRICAL

your insulations?

Ampyrol for all jobs!

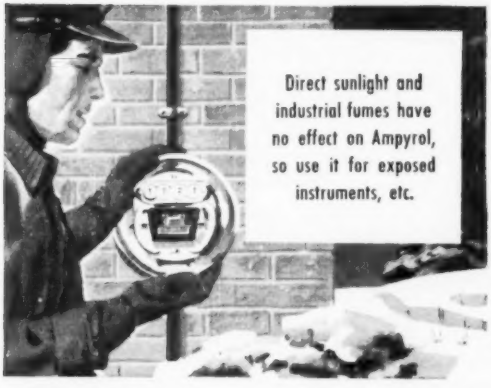
In the electrical industry, we've been developing insulations so fast that it's hard to keep track of them. But if you're looking for a special purpose insulated wire, you can usually use U·S·S Ampyrol, and get a better job in the bargain.

Ampyrol, for example, strips clean as a whistle. Many brilliant colors are available, and they run all the way through the insulation. It will not support flame yet it requires no protective armor or braid.

But the most unusual thing about Ampyrol is its almost unbelievable durability in the face of conditions that ruin ordinary insulation. Ozone concentrations that destroy rubber in a matter of minutes have no effect on Ampyrol. It withstands complete immersion in oil or naphtha for months on end. Months in a salt spray have no effect. It is unharmed by ultraviolet light, moisture, or fumes containing acids or alkalies.

In addition, for ordinary low voltage applications, very thin walls of Ampyrol can be used. It's a natural for instrument or switchboard wiring when space is at a premium.

Be sure you get all the facts on Ampyrol before you choose an insulated wire. You may be able to replace *several* types of insulation with this all-purpose wire. Send the coupon for quick information.



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ELECTRIC HAMMERS

They'll save time and money on job after job—drilling anchor bolt holes in concrete and masonry, channelling and cutting holes through walls and floors for pipe and conduit, scaling rust and old paint.

There's no cams or gears—just 3600 powerful blows per minute of one working part—THE PISTON!

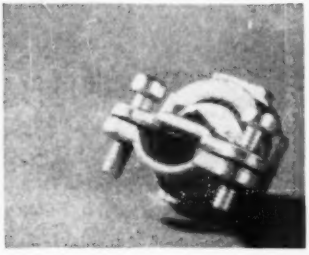
Operate from 110 volt or 220 volt A.C.

Write for free literature

SYNTRON COMPANY
892 Lexington Homer City, Pa.

and one 75-watt incandescent lamp in its lower section for local lighting on the bed. Unit eliminates necessity for overhead general lighting in hospital room. Manual control allows use of either upper or lower or both sections of fixture. Constructed of cast aluminum, unit has a ¼-inch Herculite tempered glass top which makes it dust tight, a prismatic lens tilted at an angle to project the direct light over the bed and reduce direct glare, and alzak reflectors in both sections.

Gruber Brothers, Inc., 125 South First St., Brooklyn 11, N. Y.



Cable Clamp **(40)**

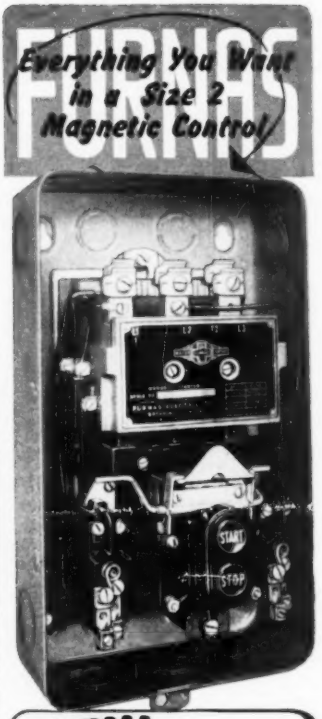
A new design of cable clamp has been added to this line. The movable portion of the clamp is of straight design rather than of the conventional curved design, with the result that the connector is ideal for the newer type "T" cable. Also, this design makes it equally suitable for the regular type of sheathed cable.

The Neer Manufacturing Co., Inc., 1640 Fairwood Ave., Columbus 15, Ohio.

Lighting Fixture **(41)**

A new industrial lighting fixture, called Direct-O-Lite. It has hinged reflectors easily adjusted to direct light where desired. It permits a wide range of light distribution—from 100% down to 100% up light with many in-between combinations. It concentrates light on the work surface. It is a 2-lamp, 40 watt fixture with HPF brick ballast. Unit is for either chain or stem mounting. Length is 49⅞ inches, width 11⅝ inches, lamp on 4½ inch centers.

Cornell Fixture Corporation, 266 Glenwood Ave., Bloomfield, N. J.



NEW Size 2

Includes starters, contactors, reversing starters and reversing switches . . . with or without built-in push-buttons or selector switches. This series is available as open type, in general purpose cases or water-tight and dust-tight cast aluminum alloy enclosures.

DUAL VOLTAGE COILS regularly furnished at no extra cost, single or polyphase, save time, reduce coil inventory.

PLASKON ALKYD ARC-BOX, most arc-resistant material available . . . fungus proof.

SPECIAL SILVER CONTACTS of high conductivity and superior arc-quenching properties.

PROVISION FOR ADDING CIRCUITS . . . Furnas Switchlets, each with normally open and normally closed contacts, may be easily attached by the user for auxiliary circuits.

RUGGED CONSTRUCTION of all parts for long life and trouble-free service . . . Direct acting solenoid type magnet and contact mechanism.

EASY TO CONNECT . . . Shallow case for good visibility; pressure type terminals are right out in front.

EASY ACCESS TO PARTS. Leads need not be removed to replace contacts . . . Coils can be quickly changed.

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FURNAS Electric MOTOR CONTROLS

1067 McKee St., Batavia, Illinois

Now A NEW CONCEPT IN LIGHT CONTROL

the Wallbox Dimmer FOR MOUNTING INTO A WALL

- *SMOOTH, STEPLESS DIMMING FROM FULL-ON TO BLACKOUT*
- *USE IN PLACE OF REGULAR ON-OFF SWITCHES*
- *WALL PLATES TO MATCH ANY ROOM DECOR*
- *CONTROLS LIGHTING LOADS UP TO 360 WATTS*
- *APPROVED BY UNDERWRITERS' LABORATORIES*

The new Superior Electric WALLBOX DIMMER is a continuously adjustable transformer to dim and brighten lights. Cool and efficient in operation it does not dissipate power in the wasteful form of heat like a resistance type control. Any number of lamps up to the full rated capacity of 360 watts may be used, and it does not have to be tailored to the load. A fuse is provided to protect the unit, and a bi-metallic thermal overload relay gives overall circuit protection.

Send today for complete information. Learn how the new WALLBOX DIMMER can give you truly effective light control. Just write to:

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THE SUPERIOR ELECTRIC CO.
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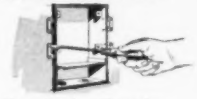
Easy to Install

As an ordinary wall switch - -



Mount box in wall opening . . . fits standard 2 x 4 wall construction.

Pull in wire (through bottom or sides).

Mount the dimmer unit in the box, secure with four screws.

Finish the job by attaching wall plate and control knob.

YOU CAN USE THIS PRODUCT

IN THE HOME

— living, dining and recreation rooms to dim or brighten light intensity to suit activity. Dim down for night light.

IN CHURCHES

— helping to create an atmosphere of dignity and reverence at the altar or in the chapel.

RESTAURANTS, COCKTAIL LOUNGES, HOTELS

— properly controlled lighting to enhance the enjoyment of food and entertainment.

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— for dimming house lights. Controlled illumination in corridors, stairways, etc.

— AND FOR HUNDREDS OF OTHER APPLICATIONS

- STABILINE AUTOMATIC VOLTAGE REGULATORS
- POWERSTAT VARIABLE TRANSFORMERS
- VARICELL D-C POWER SUPPLIES
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- POWERSTAT LIGHT DIMMING EQUIPMENT

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PIPE & BOLT THREADING MACHINE

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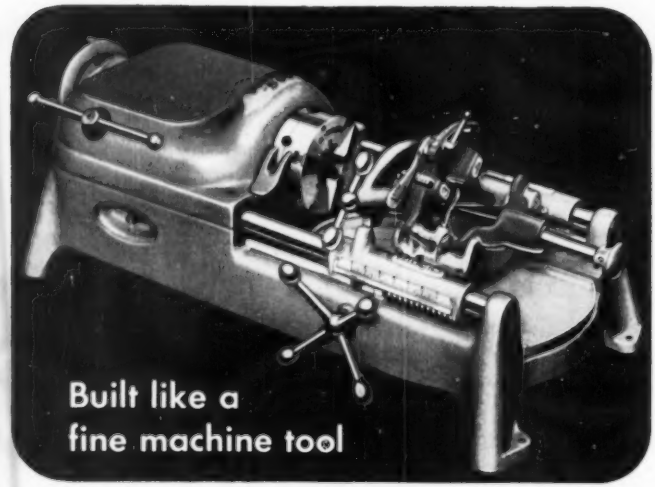

Full of typical RIDGID Improvements

- Range ⅛" to 2" conduit or pipe; ¼" to 2" bolts.
- Cutting, threading and reaming tools operate independently and right up to chuck, swing up out of way when not in use.
- New RIDGID quick-opening quadritype, dualtype and monotype die heads save time and work.
- Concealed oil system, reversible pump, no priming.
- More than 20 other efficiency improvements—write for complete profit story on this new RIDGID "500".

THE RIDGE TOOL CO. • ELYRIA, OHIO

RIDGID

Work-Saver Pipe Tools

Product Briefs

(42) A new 25-kw radio-frequency **generator** is available from the Westinghouse Electric Corp., Pittsburgh, Pa. . . . (43) Miroflector Co., Brooklyn, N. Y. has announced a new polished aluminum **reflector** with preoxidized finish to provide high intensity, directed light . . . . (44) Mitchell Manufacturing Company, Chicago, Ill., has added a **heating element** to its room **air conditioning** units.

(45) The RCA Service Company, Inc., Camden, N. J. has announced that **Teleprompter** cuing equipment, widely used in television studios, will shortly be made available to public speakers in other fields on a nationwide basis. . . . (46) **Coil forms** with special flexible flanges, known as "Flexiform" Bobbins, are available from the Precision Paper Tube Company, Chicago, Ill. . . . (47) Minneapolis-Honeywell Regulator Company's Industrial Division, Philadelphia, Pa., has announced a smaller gauge weatherproof **extension wire** for its iron-constantan thermocouples.

(48) A new differential pressure primary element **transmitter** for use in automatic control systems has been announced by the Swartwout Company, Cleveland, Ohio. . . . (49) A change from black to satin grey baked enamel as standard finish for its line of 4 by 4 **Wirewa and fittings** has been announced by National Electric Products Corporation, Pittsburgh, Pa. . . . (50) Snap-on Tools Corporation, Kenosha, Wis., has announced a light-weight two-speed soldering iron.

(51) General Electric Company, Louisville, Ky., has introduced two room **air conditioners** that will adjust themselves automatically to room temperature changes. . . . (52) Ward Leonard Electric Co., Mt. Vernon, N. Y., has developed new 25 and 50 watt Vitrohm ring type **rheostats** which feature a new contact arm and drive shaft assembly. . . . (53) New Porta-Flex bench and machine **lights** have been developed by Gardner Products Co., Detroit, Mich.

(54) Temp-O-Matic, Chicago, Ill., has developed a new automatic day-night **thermostat control** for home use. . . . (55) A new line of "Tight Tolerance" industrial **cathode-ray tubes** has been announced by the Tube Division, Allen B. Dumont Laboratories, Inc., Clifton, N. J. . . . (56) A new temperature **transmitter** for use in chemical and food processing plants, refineries, petrochemical plants, and central stations has been introduced by the Swartwout Company, Cleveland, Ohio.

(57) Globe Laboratories, Sherman Oaks, Calif., has developed a **De-Stat**

cloth, designed to solve the problem of static electricity inherent in many industrial products. . . . (58) An improved hysteresis **brake** that holds constant tension on yarn, wire, etc. by magnetic drag instead of friction has been announced by General Electric Company, Schenectady, N. Y. . . . (59) A new line of 30-, 36 and 42-inch **attic fans** which can be mounted either vertically or horizontally, are being manufactured by Victor Ventilator Company, Cincinnati, Ohio. All fans have rubber-cushioned mounts built into the fan for noise and vibration free installations.

(60) Alden Products Company, Brockton, Mass., has introduced a new **test point jack** that permits safe circuit voltage reading up to 3000 volts ac peak from the front of equipment panels. . . . (61) Arro Expansion Bolt Company, Marion, Ohio, has announced the addition of a new masonry **drill** to its line. . . . (62) Miller Electric Co., Pawtucket, R. I., has introduced "Strip-O-Lights" for creating Christmas outdoor **lighting** displays. These ready-to-assemble flexible interlocking strips can be shaped into star, tree, candle or other designs, or to frame any desired outline.

(63) A mobile **work bench** which is adjustable in height, has been announced by Sturdi-Bilt Steel Products, Inc., Chicago, Ill. . . . (64) Solar Electric Corporation, Warren, Pa., has developed an insect exterminator **lamp**. . . . (65) A new small **plier** of duck bill design is now available from Mathias Klein & Sons, Chicago, Ill. Plier is available with or without leaf spring.

(66) Two new **high-vacuum diodes**, types 6102 and 6103, for industrial use in high-voltage rectifier applications are now available from Westinghouse Electronic Tube Division, Elmira, N. Y. . . . (67) A new No. 420 Channellock **plier** is being manufactured by Champion DeArment Tool Company, Meadville, Pa. . . . (68) Two new electric hand **drills**, a general duty type with ¼-inch chuck and ½-inch capacity special duty mold, have been introduced by Porter-Cable Machine Co., Syracuse, N. Y. Both models have spindle ball-bearing construction, and Universal motors.

(69) Stable operation over wide temperature range is provided by new line of **capacitors** developed by Industrial Condenser Corp., Chicago, Ill. . . . (70) A new constant-frequency **control** designed to hold alternator frequency within 0.001% on motor-generator sets supplying up to 10 kw of power has been announced by General Electric Co., Schenectady 5, N. Y. . . . (71) A new **instrument**, Type RI-C indicator-controller, primarily designed to meet the needs of industrial control and measurement of solution concentrations, has been announced by Industrial Instruments, Inc., Cedar Grove, N. J.

NEW smoothness... NEW efficiency in powder-actuated fastening...

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Designed BY Operators FOR Operators

SEE THESE NEW FEATURES:

- 1-PIECE TOOL, *for faster loading*
- TRIGGER ACTION, *for easy operation*
- PORTED BARREL, *to reduce spall*
- ANGLE-FIRE CONTROL, *for straight penetration*
- VISI-CHEK BUTTON, *for quick inspection*
- *Plus exclusive, proved-in-use ROTO-SET SAFETY SHIELD, for accurate positioning*

Faster, lighter, easier handled, the new RAMSET JOBMASTER sets a record pace for steel and concrete fastenings. Properly trained workmen quickly become skilled operators because of smooth, simple, natural motions of loading, placing, firing. Positive controls bring improved accuracy and efficiency . . . and still lower fastening costs. Ask your dealer for demonstration of how RAMSET's years of pioneering have made the new JOBMASTER the proved-in-performance leader.

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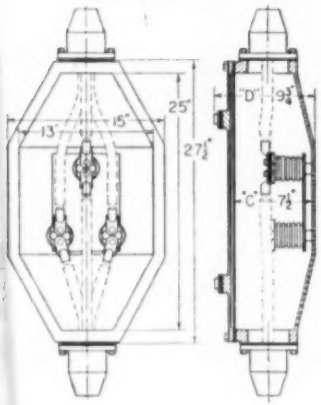
Ask for Demonstration TODAY!

cast iron splice boxes

for burying directly in the ground



G & W Type "GB" Boxes are designed for splicing armored cables up to 15,000 volts without the use of lead sleeve enclosures. All joints are ground smooth and sealed with "Resistoyl" gaskets. The cable entrances may be wiping sleeve or stuffing box. Internal connections do not require insulating with tape. Conductors are connected by soldered-on lugs, bolted to contacts which are mounted on porcelain supports. The boxes are to be solidly filled with insulating compound. The electrical characteristics are established by the proper length and spacing of the porcelain supports. No particular skill is required for installation.

The Type "GB" Box is also available as a 3 way, 3 pole, 15,000 volt unit.

WRITE OR ASK YOUR LOCAL REPRESENTATIVE FOR YOUR COPY OF THE G & W BOX BULLETIN BA52.

G&W ELECTRIC SPECIALTY CO.
7780 Dante Ave., Chicago 19, Ill., U.S.A.
Representatives in Principal Cities
In Canada, Powerlite Devices, Ltd., Toronto

Catalogs, Bulletins and Engineering Data

(72) RELAYS, telephone-type for industrial use, including hermetically sealed (in metal and glass containers) sub-miniature, plug-in types, are illustrated and described in 12-page brochure, with complete specifications, symbols and application data. Automatic Electric Co.

(73) LIGHTING EQUIPMENT, industrial fluorescent fixtures, incandescent reflectors, floodlights and vaporproof fixtures, are illustrated and described in 4-page bulletin, with specifications, construction sketches and light curves. Multi Electric Mfg. Inc.

(74) ELECTRICAL INSULATION, class B composite of varnished Fiberglas and saturated asbestos paper, is illustrated and described in 4-page bulletin, showing application to motor armatures with photos of insulation on the rotors, and including specifications. Natvar Corp.

(75) MOTOR DRIVES, including ac and dc motors, adjustable-speed drives, electronic controls and regulators, M-G sets and generators, are illustrated and described in 4-page bulletin, with specifications and application data. Reliance Electric & Engineering Co.

(76) INCANDESCENT REFLECTOR for hi-hat, bullet and open socket, is the subject of 4-page bulletin, including specifications and light curve on this unit of high reflectance and special design. Miroflector Co., Inc.

(77) CIRCUIT BREAKER manual explains operating principles of basic CB designs, emphasizing branch circuit protection, with application data, diagrams of three basic types, charts on temperature factors, inrush current effects, tripping and reset time, and time-delay curves. Heinemann Electric Co.

(78) ELECTRIC PHONES, sound powered, requiring no batteries, no electrical hazards, no maintenance, and using current generated by the voice itself, are illustrated and described in catalog covering sound powered communications for industrial and commercial use, with installation data and wiring and dimension diagrams. The Wheeler Insulated Wire Co.

(79) RECESSED LIGHTING system, consisting of two basic fixture sizes with three basic shielding elements, designed for use with grid type suspended ceilings, is subject of 4-page bulletin, including data on installation of units to form tees, crosses, rectangles and other patterns of light. Day-Brite Lighting, Inc.

(80) MOTOR CONTROLS, magnetic "right angle" type, are illustrated and described in 4-page, 4-color folder, including operating characteristics, construction details and specifications. The Arrow-Hart & Hegeman Electric Co.

(81) CURRENT TRANSFORMERS, large window "Donut" instrument types, for extending the range of ammeters used for determining current flow in large conductors, are described and specified, with illustration, in data sheet. Associated Research Inc.

(82) CARBON BRUSH data book for fractional hp motors contains 66-pages of complete carbon brush replacement information, listed by appliance and motor manufacturers' names, with full indexing and illustrations. Becker Brothers Carbon Co.

(83) TROFFER LIGHTING fixtures, fluorescent for recessed mounting in acoustical ceilings, are illustrated and described in 12-page folder, including data on the different shielding media, specifications, candlepower curves, construction and installation sketches, and coefficients of utilization. Gruber Lighting.

(84) CONTROL PANELS, industrial type, are illustrated and described in 2-color catalog sheet, including application data and wiring photos of the automatic units. Industrial Control Panel Co.

(85) LUMINOUS CEILINGS in the largest installation of its type in the East are illustrated and described in color in 8-page booklet, including lighting design data, calculation tables, installation details, sketches, layout diagram and different areas in the installation. Rem-Lite Inc.

(86) CABLE TROUGHS, expanded metal type for supporting power and control cables, are illustrated and described in 12-page catalog, including typical installations, loading and deflection curves and a three-scale tracing template. T. J. Cope, Inc.

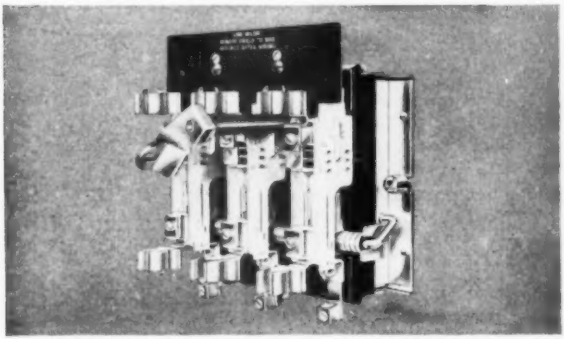
Here's what you want to give your customers in safety switches

- Maximum protection for electric circuits and personnel
- Ease and flexibility of installation
- Convenient and safe maintenance

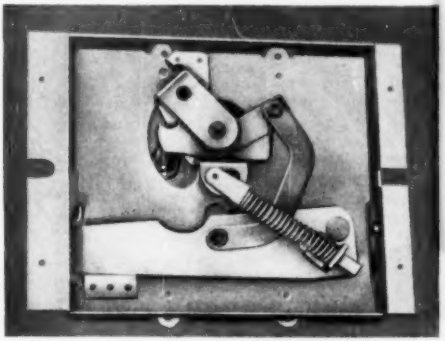
...and here's how a Trumbull HCI safety switch* comes through on every count

*Meets NEMA types I and IA specifications.

1. START ON THE OUTSIDE—*THE ENCLOSURE.* Made of heavy gauge steel, specially treated and then coated with high-baked enamel for corrosion resistance. That *handle* is important, too. It has a releasable interlock for use of authorized inspectors only and will take three padlocks. The *cover latch* may be locked independent of the handle so the switch can be operated but not tampered with. The front is provided with a gasket, making the enclosure semi-dust-tight. Inside there's ample room for wiring—and plenty of *knockouts*. Three mounting holes make possible easy leveling and allow mounting on uneven surfaces.



2. REMOVE THE *INTERIOR UNIT.* Just loosen two screws and the whole interior slips out. The *pole units* are self-contained for easy removal without disconnecting wiring and use *silver-plated current-carrying parts . . . arc-resisting, linen-melamine insulating parts.* U-shaped *movable conductors* bring gap between line and load contacts to less than ½ inch reducing possibility of arc damage. Exclusive design of *pole units* and *contacts* take advantage of magnetic repulsion principle to give maximum arc-quench and contact bind (look further into this feature; it's the key to the long life expectancy of the Trumbull HCI).



3. BE SURE TO STUDY *OPERATING MECHANISM.* Underside of the HCI interior shows this operating mechanism which is protected by a riveted *cover plate.* It uses a *roller-cam action* and a multiplying *linkage* design with a powerful *spring* that always throws to full OFF or ON. No halfway position because there's no dead center.

Write for full data on Trumbull top quality, heavy-duty industrial safety-switch line—the HCI. Ask for Bulletin TEC-10.

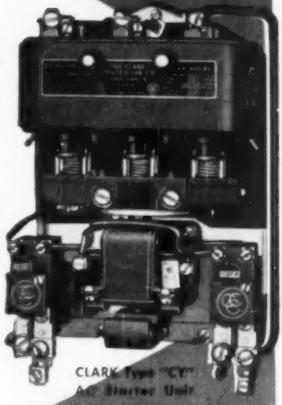
TRUMBULL (T) ELECTRIC

DEPARTMENT OF GENERAL ELECTRIC COMPANY

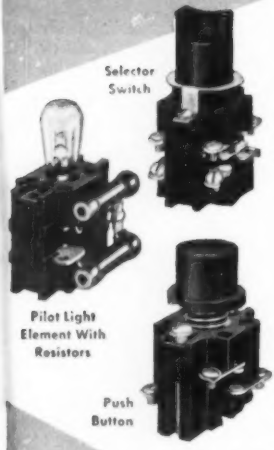
PLAINVILLE, CONN.

Why CLARK is THE CONTROL LINE for alert Contractors to use on Industrial Installations

WE START with this basic unit of the *CLARK Type "CY" AC MOTOR STARTER*, in sizes 0, 1, 2 and 3—the starter with the revolutionary arc quenching principle that gives record-breaking performance . . .

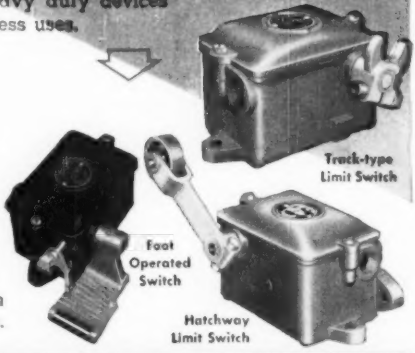

CLARK Type "CY" AC Starter Unit

- **WE ADD**—Relays, safety switches, circuit breakers, transformers, etc. . . .
- **WE ADD**—Various types of enclosures—standard, dust-tight, water-tight, explosion resisting, etc. . . .
- **YOU GET**—Thousands of different arrangements and combinations for starting, stopping, reversing, plugging, jogging, speed changing, motor protection—for every conceivable AC application.



THEN ADD these three basic units to your line—*CLARK PUSH BUTTON, PILOT LIGHT* and *SELECTOR SWITCH*. They come in hundreds of different heavy-duty combinations and enclosures to provide actuating and/or indicating service for every possible use. Also available are many combinations in standard-duty buttons.

ADD ALSO the dozens of possible combinations of *CLARK FOOT OPERATED, HATCHWAY* and *TRACK TYPE LIMIT SWITCHES*—all heavy duty devices applicable to countless uses.



- **AND DON'T OVERLOOK** the many larger *CLARK* AC Starters and Contactors, DC Starters and Contactors, AC and DC Relays, High Voltage AC Starters, Control Centers, for complete industrial electrical control installations.

Put all these together and it's easy to see why

CLARK is the IDEAL LINE for you to use on industrial electrical control installations.

THE CLARK CONTROLLER CO.

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QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Reader's Quiz

Testing Motor Leads

QUESTION X21—We recently installed a battery of nine spray booths each having a 3 phase 220-440 volt motor with 9 leads. After the booths were set up and motors connected, we found all the motors had the leads improperly tagged and would not run.

We removed the motors and sent them to a motor shop in the vicinity where they tested and marked the leads. When we reconnected them, all worked O.K. I would like to know if there is a simple way to test this type of motor when some of the tags are lost or if the leads are improperly tagged. Can this be done with ordinary instruments or is special equipment required?—E.E.M.

ANSWER TO X-21: Below is the method we use at our plant for tagging the leads on a 9 lead 220/440 volt 3 phase motor. We have used this method with good results for about 4 years. The nice thing about it is that most any electrician can understand and use it without making mistakes.

DETERMINING LEADS ON NINE LEAD MOTORS

1. Check nameplate.
2. Obtain proper Voltmeter & battery (3 volt dry cell and 3 volt meter, direct current).
3. Lamp coils—determine groups of coils.
4. Start with leads 7, 8, 9 which indicates Y.
5. Hook battery across *7 & 9.
6. The pair of leads which gives least or no reading is considered to be 2 and 5.
   (Note hook Voltmeter on each pair then kick battery lead)
7. Arrange meter leads so that meter kicks up scale on the make.
8. Kick *8 & 9—leads giving little or no response are considered to be 1 & 4.
9. Therefore the remaining pair of leads are 3 & 6.
10. With battery across *8 & 9 put Voltmeter across *2 & 5 so that meter reads up scale.
    (If 5 has polarity instead of 2, reverse tags)

DOUBLE CHECK

With battery across	Check these leads
*7-8	*1-4
*7-9	*1-4
7-9*	*3-6
8-9*	*3-6
*8-9	*2-5
7-8*	*2-5

Meter must read up scale at all times.

The voltmeter we use is a Triplet Model 327-T and one 3 volt dry cell or two 1½ volt No. 6 dry cells connected in series. It can be done with one No. 6 dry cell but the kick on the meter is not so easily read.—T.L.C.

Testing Condensers

QUESTION Y21—I would like to know a method of testing small motor condensers. I have found that to test for continuity and for flash is not always correct.—C.S.S.

ANSWER TO Y-21: Continuity tests of a condenser only determines if there is an open circuit in the condenser. Flash tests determine whether there is a short-circuit between conductors or a ruptured dielectric. The best practical shop test of a condenser is to connect it across the line of proper voltage in series with a 10-amp fuse. If the fuse blows the condenser is shorted. If it does not blow connect an ammeter series with the fuse and condenser and take a reading to be used in the following formula to determine the true microfarad capacity of the condenser under test.

$$\text{Mfd} = \frac{2650 \times I}{E}$$

I is amperes, and E is applied voltage. Compare the obtained result with the rating on the condenser.—J.A.

ANSWER TO Y-21: I find that I can check condensers, good or bad. Using a small 60 watt lamp in series with a test circuit with alternating current I charge these small condensers and then discharge them with a rod or with an insulated handle at one end. The 60 watt lamp will light up when you charge the condenser and will also light up if the condenser is shorted. If you get an arc when discharging, the condenser is good, if no arc is visible the condenser is no good, then repair if possible or destroy it.

In the event the condenser shows discharge, take the 60 watt lamp out and put a small amp fuse in its place and apply full voltage across the condenser. When you apply the voltage rating of the condenser be sure the condenser is kept away from other members of the crew, as it is possible the condenser may blow-up, in fact, if the condenser can be covered in a heavy metal box—it would be safer. This is only a precaution. I have had them blow apart on me. In the recent past I did not apply the full voltage but the maximum of 220 volt ac, covered in a metal box.—O.C.

Electromagnetic AC Solenoid

QUESTION Z21—We have a problem involving the use of an electromagnetic ac type of solenoid. Owing to the fact that the solenoid has a very high inrush, we have been hesitant about using this for more than infrequent duty. Is there any way of checking or calculating the maximum number of operations per minute that a solenoid may operate?—H.H.S.

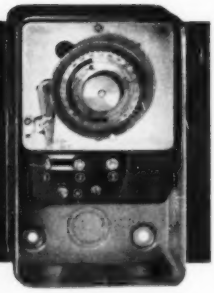
ANSWER TO Z-21: I would suggest inspecting the solenoid for the kind of insulation on the wires. The maximum allowable temperature for the particular kind of insulation can be found in any electrical handbook.

To very roughly estimate the number of allowable operations per minute, operate the solenoid at a low rate for the usual length of time and note the temperature of the solenoid. Then by algebraic proportion the safe maximum number of operations per minute can be computed for the particular room temperature.

If the solenoid has very many layers, the temperature in the center layer will be very much hotter than at the surface. To be on the safe side, use a safety factor of about 2. For other thicknesses vary factor between 1 and 2.

To get a more accurate value, plot a curve after noting temperatures for 3 or 4 rates. Do not exceed 60% of the maximum rate computed very roughly. Then extend the curve keeping the curvature and rate of charge of slope of curve about the same until you reach the maximum allowable temperature. Then you can read the maximum allowable rate of operation from the curve on the graph paper. If the solenoid is not ruggedly made do not go over 75% of the allowable maximum operations per minute.—E.B.

FOR COMPLETELY RELIABLE
TIME SWITCHES
Be Sure You Specify
PARAGON!



On any application . . . controlling yard or remote building lights . . . operating motors, stokers, burners or other industrial equipment . . . the time switches you use *must* be reliable. That's why it's smart to use Paragon's *built-in* accuracy and reliability.

Available in a wide variety of types and models for all "ON and OFF" timed-switching operations — indoor or outdoor. Time switches . . . interval timers . . . 7-day program controls . . . cycle repeaters . . . time-delay relays and reset timers . . . there's a dependable Paragon Time Control to fit your needs. 300 Series from $10.50 list.

Illustration shows Model 301 straight "ON and OFF" Time Switch for use where two or four operations per day are required. Self-starting, heavy-duty motor, available in 115 or 230 volt, SPST, SPDT and DPST models.

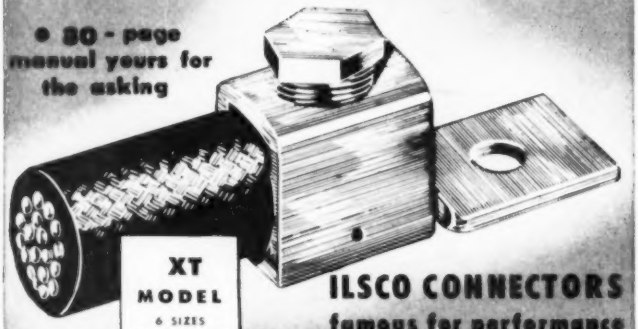
SEE YOUR JOBBER OR WRITE FOR INFORMATION AND CATALOG

PARAGON ELECTRIC COMPANY 1614 TWELFTH STREET TWO RIVERS, WISCONSIN

WORLD'S LARGEST EXCLUSIVE MANUFACTURER OF TIME CONTROLS FOR ALL USES

be modern | go ILSCO

• 80-page manual yours for the asking



XT MODEL
6 SIZES
#14-500 MCM

ILSCO CONNECTORS
famous for performance
U/L TESTED

ILSCO COPPER TUBE AND PRODUCTS, INC.
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ANSWER TO Z-21: A simple and practical method of determining the safe duty cycle of a solenoid is to check its coil temperature rise. Safe operating temperature is limited by the type of insulation used in the coil. This should be obtained from the solenoid manufacturer. With this information a thermometer can be held on to the coil with putty or some other suitable compound and the temperature rise noted for various duty cycles. When the temperature reaches the prescribed limit, obviously its duty cycle has been determined.

If the above information is not readily available a good approximation of the duty cycle can be determined by simply feeling the solenoid coil with the hand. A rise above 140° F. is too hot and this can be roughly used to determine the duty cycle.—R.E.B.

Protection Against Lightning

QUESTION A-22—Just which is superior and how much for protection against lightning—a lightning rod or a lightning wire? It is claimed that ammunition and explosive store houses are all protected by lightning wires. A lightning wire being a bare wire stretched above the building to be protected and the wire being grounded. —E.B.

ANSWER TO A-22: I believe the choice between lightning wires and lightning rods is a matter of cost, which in turn depends upon the area to be protected. For a small building a rod would be the best choice. For a long narrow building lightning wires would probably be cheaper. An exaggerated example is a transmission line where (the area to be protected being long and narrow) lightning wires are used.—P.S.

ANSWER TO A-22: Power companies sometimes put the ground (neutral) on top to protect the line from lightning, but they also at regular intervals place a point on the top of a pole and ground it. The theory behind a lightning rod is what science calls the "discharge of points". These pointed metal rods are connected to the ground and the point discharges electrons to the cloud above neutralizing its unbalanced charge keeping it from discharging to the ground in the form of lightning. The sharper the point the more readily it will discharge electrons.

It is my belief according to the above that the pointed metal lightning rod would be superior to a wire held horizontal to the cloud.—G.J.

ANSWER TO A-22: A sufficient number of air terminals or points as one point for every 25 feet of ridge is considered better than one long grounded wire above the ridge. A down conductor to ground at opposite corners of building and an additional down conductor to ground for every 50 feet of ridge such as one on each of four corners for a 100 ft. building.

The codes for protection against lightning put out by the U. S. Dept. of Commerce gives complete information on proper methods of protection for all types of buildings.—E.E.M.

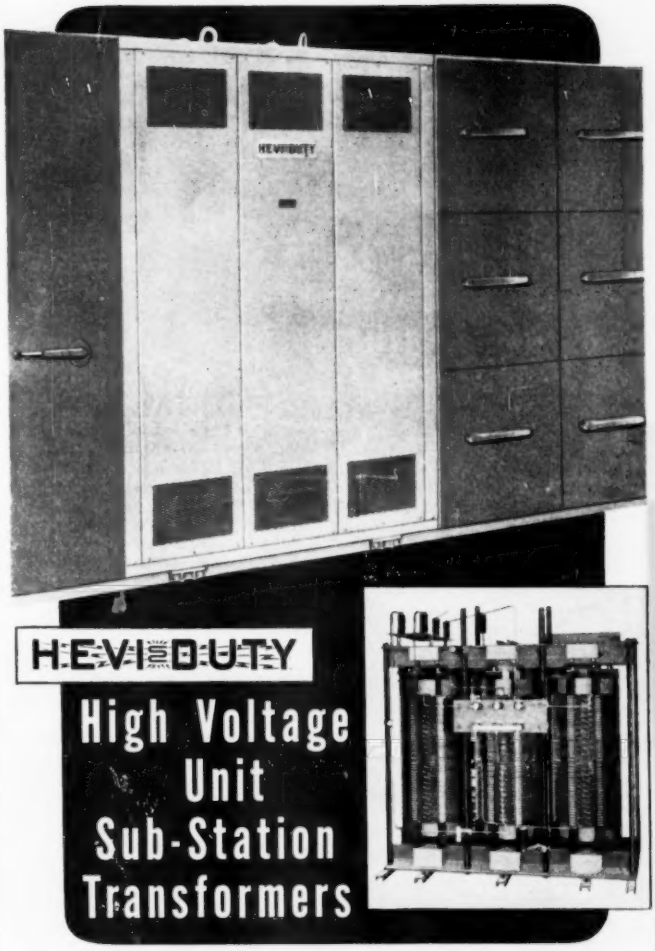
Breakdown of Capacitors

QUESTION B22—What can be done to overcome the continued breakdown of capacitors on a 3 hp single-phase motor? This motor is started and stopped continuously and after this operation for a week or so, the capacitors are defective. Is there any remedy, besides replacing with a repulsion-induction type motor?—E.S.H.

ANSWER TO B-22: Under conditions as described in the question, it is evident that the capacitors are subjected to an abnormal duty cycle. The various manufacturers have their own stated operating conditions for their capacitors, and are sometimes found on the capacitor label. This should be checked.

It would be advisable to take readings of the voltage across the capacitor terminals. Between 135 and 140 volts is the approximate high limit for capacitors on 115-volt 60-cycle motors. If this voltage is found to be too high, more capacity is needed. A voltage reading of 10% above line voltage is a safe value. If operating conditions are too severe for the capacitor, it is suggested that capacitors of approximately twice the rated voltage of those presently in use be substituted; or, the replacement with non-electrolytic units rated for continuous duty would eliminate the present breakdowns.—L.N.W.

ANSWER TO B-22: I would suggest checking the capacitors before they are put on the motor to see that they are in good condition and then use one-half the capacity of the one condenser but of the same voltage rating as the single condenser. This may possibly add to the life of your capacitors, and might save replacing the capacitor motor with another type. In any case do not exceed the capacity of the original condenser even if it should be found necessary to increase capacitor voltage rating.—L.C.D.



HEVI DUTY

High Voltage Unit Sub-Station Transformers

INCREASE EFFICIENCY OF LIGHTING AND POWER CIRCUITS BY SUPPLYING EQUIPMENT WITH THE CORRECT VOLTAGE

When you need electric power, you can count on Hevi Duty Dry Type Transformers for dependable service. These transformers are engineered to meet or exceed all the requirements necessary for long life.

Note the adequate core and coil blocking, high voltage insulators and well ventilated pancake type coils on the Type 31FH, 300 KVA, 13,200-208Y/120 volt, 60 cycle Transformer shown here.

Hevi Duty Dry Type Transformers can be supplied separately or as a Unit Sub-Station complete with primary and secondary switch gear according to your specifications.

Write for Bulletin HD-499.

HEVI DUTY ELECTRIC COMPANY

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Heat Treating Furnaces... Electric Exclusively

Dry Type Transformers *Constant Current Regulators*

ONE for the money!

KEYSTONE
Flangeless WIREWAYS and FITTINGS!

"One for the money" is right! Next time you're bargain-hunting for quality wiring installation equipment, you'll find it pays extra sales and profits dividends to specify KEYSTONE Flangeless Screw-cover WireWays and Auxiliary Fittings. They're quality-built through and through . . . yet they're designed to permit quick, easy, economical installation of wiring for meter boards, service boards, loadside switches, etc.

Available in three sizes . . . 4" x 4", 4" x 6", and 6" x 6" . . . and in foot-lengths of 1' through 5' inclusive. Furnished in a variety of knockouts ranging from ½" to 1¼" equally spaced every 3" for making ample connections without costly drilling. Flangeless type 90° elbow and T fittings also available for added flexibility in meeting wiring lay-out requirements. Write for Keystone's "Value-Packed" Catalog today!

• It pays to "figure on Keystone!"

NOW! Territories open for agents with warehouse facilities. Write for full particulars!

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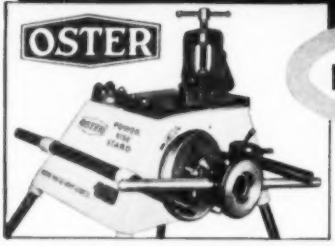

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POWER VISE STAND

The leading, portable power drive for hand pipe tools. Range 1/8" to 2" pipe. With drive shaft 2-1/2" to 8" pipe.

YOU CAN GET IT NOW
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Take advantage of the quick availability and present low price of the Oster POWER VISE STAND! If you don't know the names of Oster Distributors in your locality, or want complete information on the No. 422 machine, just fill in the form below, tear out, and mail to us.

THE OSTER MFG. CO. 2081 East 61st St., Cleveland 3, Ohio, U.S.A.

☐ Rush copy of catalog bulletin on No. 422 POWER VISE STAND.
☐ Rush names of Oster Distributors in our area.

NAME
COMPANY
ADDRESS

Selenium Rectifiers

QUESTION C22—Is it correct that mercury vapor from a broken thermometer or fluorescent globe can cause a selenium rectifier to fail?—H.S.

ANSWER TO C-22: A globule of mercury from a broken thermometer can cause a selenium rectifier to fail. Mercury readily combines with selenium to form a selenide and the microscopically thin selenium layer is almost instantly destroyed by contact with mercury. There have been cases of rectifiers ruined by mercury from a broken glass thermometer bulb, during heat runs. The only safe type of thermometer to use around a selenium rectifier is the mechanical dial type.

No records are available that show similar danger from broken fluorescent lamps. The amount of mercury in this case is much less than in a large glass thermometer bulb. However mercury from any source at all is highly detrimental to the thin film of selenium on which the rectifying action depends.—S.O.H.

ANSWER TO C-22: Where air surrounding selenium rectifier is only mildly corrosive or humid, manufacturer's original varnish is ample protection. With mercury vapor, oil-immersed selenium rectifiers should be used as in all excessively corrosive or humid atmospheres. Always be sure rectifier stacks are vertical with sufficient air flow. If surrounding temperature is continuously above 96° F., rectifier should be derated for equalizing output vs operating temperature in accordance with manufacturer's charts.

For best service, check rectifiers monthly particularly so ac voltage isn't greater than rectifier rating. Overvoltage damages stacks by causing shorts. Overheating shows up as small solder beads on disc underside. Rough blemishes near pressure washers and selenium coatings show where selenium has shorted through. Ac wattmeter, moving coil dc voltmeter and ammeter check voltampere efficiency. Usual efficiency runs 65 to 85% depending on circuit. Efficiency should be fairly constant from 20 to 150% test load on rectifier.

Aging increases rectifier resistance, reducing dc output voltage 5 to 10% depending on service. It also lowers efficiency. New units connected to aged stacks may cause current unbalance because forward and inverse resistances are different. After making electrical checks, see that rectifier is free of mechanical damage and hasn't been abused in any way. Look for support or frame grounds. Test each terminal to ground. Excessive dirt lowers stack resistance.—L.W.F.

Can you ANSWER these QUESTIONS?

QUESTION N22—If it is known that the power factor of a manufacturing plant is poor what steps should be taken to correct the fault? The plant operates on 220 volt, three phase, 800 ampere service. Largest motors are 15 hp. What would be the type, size and location of capacitors to correct from 70% power factor?—G.J.

QUESTION P22—How can I locate conduit with or without an outlet box that was plastered or cemented in a wall or reinforcing ceiling? H.S.

QUESTION Q22—We have several transformer type ac welders with 220 volt primary and approximately 40 volt secondary. There are no taps on either the primary or secondary. The secondary output is controlled by a reactor coil in series with the secondary—this reactor on one leg of a transformer type structure and two dc coils on the other leg, output varying according to the dc input. What is the principle of this control? How does it affect the wave form of the output?—S.R.U.

QUESTION R22—We had a case recently where a 1/3 hp oil burner motor would lower the voltage at the 100 amp main switch about 16 volts. At the same instant, the other side of the service (3 wire 2 voltage) would rise about 14 volts.

With the main switch in "off" position, the voltages were 114 volts and 126 volts at no load. So when the motor started, the low side dropped to about 100 volts, and the high side increased to nearly 150 volts.

Two single phase transformers were parallel on secondary side and were located quite distant apart. They both had secondary fuses in each of the two hot wires, neutral was solid.

One of these fuses on the nearest transformer was blown, and replacing fuse seemed to correct practically all of the abnormal variations.

I know that circulating currents, harmonic voltages, and neutral currents can cause some queer conditions, and I have a fair idea of how this came about. However, I want to explain it to others, and cannot make up an understandable sketch or explanation.

Can someone help me out on this without making it too technical or mathematical?—M.C.T.

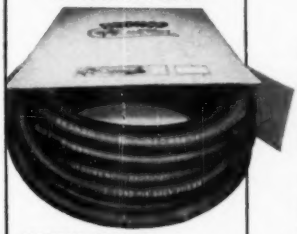
PLEASE SEND IN YOUR ANSWERS BY JANUARY 15

BE CERTAIN

GET BRONCO *Certified*

the portable cords and cables with 60% by weight Neoprene jackets.

BRANDED!



BRANDED JACKETS! No mistake . . . You know you are getting *Certified*. You read at a glance cable type, size, voltage, "P116BM". . . which indicates approval by the Pennsylvania Bureau of Mines, and acceptance for listing by the U.S. Bureau of Mines. Easy to measure..."Bronco" is repeated every 2 feet.

With Bronco 60 *Certified* you *know* you are getting a full 60% *by weight* of Neoprene in your cable's protecting jacket because its contents are *certified*.

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Questions on the Code

Answered by

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*

GLENN ROWELL, *Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.*

B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*

F. N. M. SQUIRES, *New York Board of Fire Underwriters, New York, N. Y.*

Rating of Service Switch

Q. *What size service switches or disconnects would be required in each of the following cases?*—F.C.

A. All of these cases come within the scope of Section 2351, 2371 and particularly Section 2357 of the code.

Case 1. Each installation consists of more than two, 2 wire branch circuits, therefore, a 60 ampere switch, minimum (or a 50 ampere circuit breaker, minimum) must be installed for each of the six service switches.

Case 2. The main service switch would have to be at least 60 amperes capacity (or 50 ampere circuit breaker, minimum) since it controls 32, two wire branch circuits. Actually the main switch (or circuit breaker) size may have to be larger than this to comply with the first requirement set up in 2357, viz., "A service switch shall have a rating not less than the load to be carried determined in accordance with Section 2203."

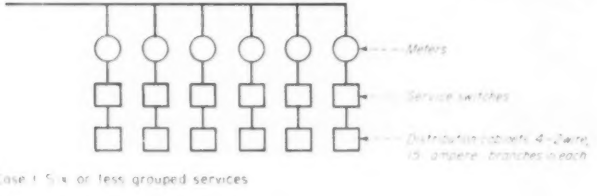
The supplementary disconnects, if installed, could be three wire, 30 ampere, 125/250 volt, solid neutral switches.

Case 3. Each service switch would have to be a 60 ampere minimum size, or 50 ampere size, minimum, if circuit breakers were installed.—B.Z.S.

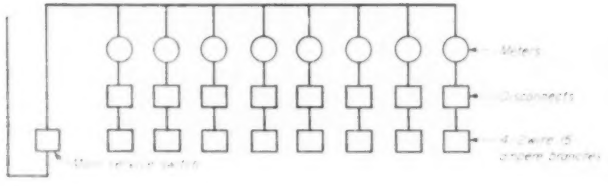
Connecting Burnishing Wheels

Q. *We have just connected several new burnishing wheels installed in an aluminum foundry and we used short lengths of flexible conduit between the rigid conduit and the motors to dampen out vibration. Now the local inspector tells us we must replace this flexible conduit as he cannot O.K. its use under such circumstances. Does the Code prohibit the use of flexible metal conduit in such a case?*—E.M.P.

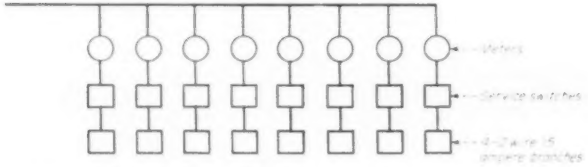
A. Yes, under Section 5054 a. 2. you will find a ruling which states that "where dusts are of an electrically-conducting nature, flexible metal conduit shall not be used". It would seem, therefore, that the inspector was correct in refusing to O.K. the use of flexible conduit under a burnishing wheel on which aluminum castings were polished inasmuch as the operation of such a machine will give off electrically conductive aluminum dust making the area immediately about the machine a Class II location. You will also note under this same section that permission is given to use a flexible cord connection provided dust-tight seals are used on such a cord and that the cord assembly is of the type that is approved for extra hard usage and that it contains in its assembly an additional conductor for grounding the motor.—G.R.



Case 1. Six or less grouped services



Case 2. More than six grouped services



Case 3. More than six individual services

Water Heater Switches

Q. *Does the Code require water heaters to be controlled by a separate switch?*—M.V.

A. Since a water heater would be classified as an appliance, the rules of Section 4241, covering the disconnecting means for appliances apply. Reference to these rules shows under 4241, the first paragraph, that an appliance must be provided with a means of disconnect. Section 4241-b, which covers stationary appliances, permits the branch circuit switch or circuit breaker to serve as the disconnecting means, provided it is readily accessible to the user of the appliance. As a result of these Code requirements, a water heater could use for its dis-

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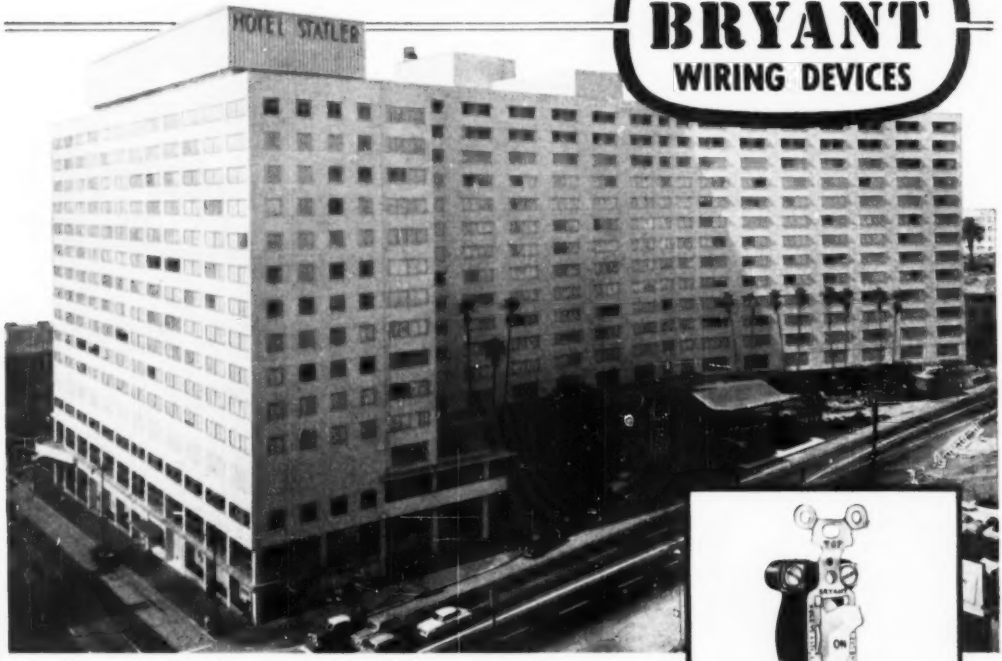

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connecting means an individual switch or the branch circuit switch, provided they were accessible. Since the average type of water heater uses a full circuit, the disconnect requirement is usually satisfied, in single dwellings, by the installation of a fused switch or circuit breaker at the main panel which serves the dual purpose of providing a separate branch circuit and also the water heater disconnect. Since Section 2126-c recognizes a range and a water heater on a 50 ampere branch circuit, it also follows when such a circuit is installed that the circuit switch or circuit breaker would be recognized as the disconnect for the water heater.—B.A.McD.

Armored Cable Switching

Q. *Will you please inform me if the accompanying drawing of a two wire BX installation is dangerous or in violation of the Code. The service is 120 volt solid neutral with two fused circuits. The same information is requested for the rubber covered lamp extension cord to the switch in the other drawing.*

Two wire BX installation with ground strap used in place of white wire for switching. Must 3-wire BX be used instead? Service is two wire 120 volt solid neutral with two fused circuits.

Switch in white wire which is connected to screw shell of the lamp. Is this installation permissible or more safe than switching the black wire in the normal manner?—C.J.

A. *Fig. 1*—In order to satisfy the Code requirements for polarity identification covered by Section 2006 and also the requirements for conductor insulation as covered by Section 3102, it would be necessary to use a 3-wire armored cable between the fixture outlet and the switch box as shown on Fig. 1. Section 2006-c of the Code permits the connection of a white wire to a black wire when armored cable is used for a switch loop. The Code however does not permit the connection of a white wire to a black wire as shown on the diagram. The use of the ground strap in place of an insulated conductor is also a Code violation which could result in serious hazards in the event of polarity reversal or poor cable connections.

Fig. 2—I assume, in this diagram, that conduit runs to a fixture outlet which is controlled by a cord pendant supporting a switch, and the black wire is connected to the center terminal of the socket. Your proposal to connect the switch in the ground wire violates Code Section 3801 which prohibits switching in the grounded conductor unless the switch simultaneously disconnects the ungrounded conductor. When the switch is placed in the grounded conductor of a 2 wire circuit, the lamp with the fixture wire or whatever may be connected to the outlet retains full voltage to ground when the switch is in the open position and in the event of an accidental ground on the grounded wire or the lamp, the circuit would not be controlled by the switch.—B.A.McD.

Wiring Fixtures

Q. *We are now engaged in a controversy over the method of wiring fixtures mounted end to end where we have proposed the use of a multi wire branch circuit supplying 16 four-lamp fluorescent fixtures in a continuous row. Each row of 16 fixtures will be supplied by a multi wire branch circuit consisting of two ungrounded conductors and a common neutral with eight fixtures on each circuit. A round knockout in each end plate will be removed and the three conductors will be run through this knockout from one fixture to the next and now we are told that we must place a nipple in this knockout with a bushing on each end to protect the conductors where they pass through the end plates. Is that required by the Code?*—M.A.R.

A. The Code requires protection for the conductors wherever they pass through a knockout in a rather indirect method. Under Section 4150 of the Code, you will note the following:

"Fixtures shall not be used as a raceway for circuit conductors unless the fixtures meet the requirements for approved raceways, except that the conductors of the single branch circuit supplying the fixtures may be carried through an installation of fixtures approved for end to end assembly to form a continuous raceway."

Therefore the whole thing hinges on fixtures approved for an end to end assembly and under standards governing the construction of such fixtures we find the following requirements:

If conductors pass through an opening in a sheet metal wall which is .043 inches or less in thickness, they shall be reliably held away from the edges of the opening or shall be protected by a bushing, a grommet, a rolled edge of metal or the equivalent. A bushing, if used, shall be securely held in place and an insulating bushing shall be not less than ⅛ of an inch in thickness. The edges of an opening in sheet metal thicker than .043 inches shall be treated to reduce the possibility of abrasion of the insulation by the removal of all burrs, fins and sharp edges.

Therefore, where the opening is provided by the removal of a knockout, it is not possible that that opening will be free of all sharp edges. Hence it is necessary that some type of method shall be employed which will keep the insulation on the conductors away from the metal edge. This might be a bushing of either conductive or insulating material. In no case should a soft rubber bushing be used.—G.R.

Fig. No 1

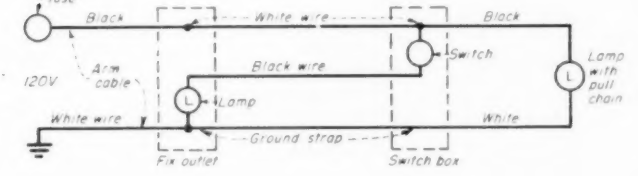
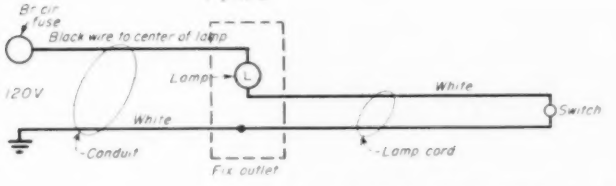


Fig. No 2



Bare Neutral Overhead

Q. *Since weatherproof wire is short and since I have plenty of bare copper No. 6 and No. 4, I wonder if there is a reason that I could not use it for a neutral on rural wiring*

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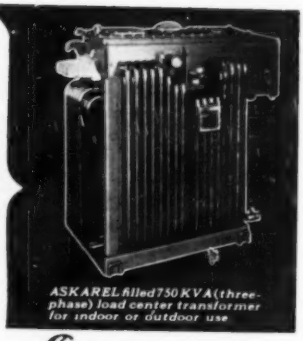

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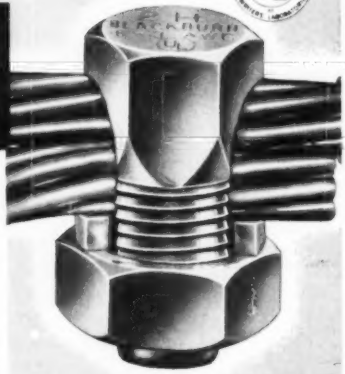

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jobs? A local utility has a guide from one pole to another and used guy wire as a neutral. Is this not violating the Code as the guy wire is steel?—K. K.

A. It appears to me that your question concerns the use of bare copper for grounded neutral conductors used outside of and run between buildings on rural jobs. If we consider the question from the angle of use as a service drop, as covered by Article 230 on services, we find that Section 2303-c requires all open individual conductors of service drops to be insulated and this includes the grounded neutral conductor. This opinion may be verified by reference to Official Interpretation No. 223 issued on November 22, 1941.

Since the service drop includes that portion of overhead service conductors between the last pole or other aerial support and the first point of attachment to the building, it is obvious that we have a definite committment on this point. If the procedure followed by the Utility involves the service drop, there is a definite Code violation. If however, the procedure is confined to their distribution system, beyond the connection to the service drop, the only rule which I believe is involved is Section 7313, which requires insulation on all open conductors when run within ten feet of a building or structure.

The same reasoning applies to your question concerning the use of a bare copper neutral conductor. Rule 7313 applies and the neutral must be insulated if run within ten feet of a building or structure.—B. A. McD.

Gaging Conductors

Q. *In discussing Table 18 of Chapter 10 we found a few discrepancies between the AWG (Standard American Wire Guage No. 281) manufactured by Starret, which we use in our shop and the table 18 in our NEC book.*

As an example, let's take a No. 6 wire (AWG). Our gauge shows a diameter of .162, which when squared equals 26244 c.m. or 26250 as stated in the Code book. However, in the NEC book the same No. 6 wire has a diameter of .184, which when squared equals 33856 c.m.

No. 4 wire, according to the AWG has a diameter of .204, but according to the NEC it is .232. Will you please explain how these differences got in and why?

Will you please show how, according to the NEC, you obtain a 83690 c.m. area for a No. 1 wire, with the diame-

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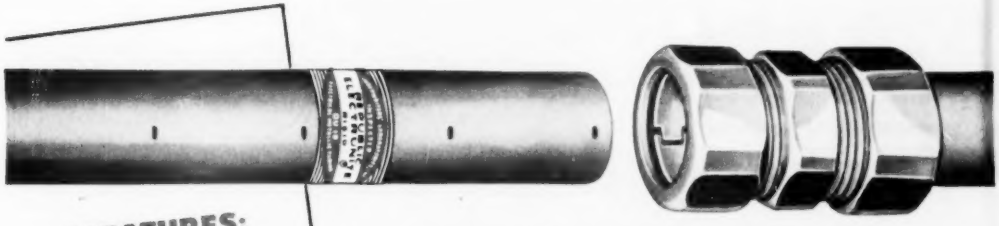

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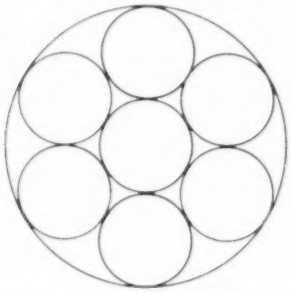
ter shown in the Code book; the square root of .8369 is .289 which is the diameter given by the AWG but is different in the Code book.—J.G.

A. It will be noted that Table 18 shows the properties of copper conductors, which are solid wires for AWG sizes No. 18 to 8, inclusive, and which are stranded wires for all sizes including No. 6 and larger. Section 3104 requires all conductors, No. 6 and larger that are installed in raceways, to be stranded.

In column 2 of this Table are shown the circular mil areas of the various sizes of conductors. These areas are the actual cross-sectional copper areas of each size of wire. Thus, for example, referring to No. 6 wire, it will be noted in Column 3 that this conductor consists of 7 strands. Column 4 shows that each of these strands has a diameter of .0612 inches. This is equivalent to .612 x 1000 = 61.2 mils diameter. The area of each strand, in circular mils, is 61.2 x 61.2 = 3745.44 circular mils. The total area of the seven strands, or the No. 6 conductor is 7 x 3745.44 = 26,218.08 circular mils. This checks very closely to the nominal value of 26,250 circular mils shown in column 2 of the table.

As another example, the 1000 MCM conductor has a calculated copper cross sectional area equal to (.128 x 1000)^2 x 61 = 999,424 circular mils.

Referring to the No. 6 conductor, its nominal cross section will look somewhat as shown by the following diagram (Not drawn to scale):



It should be noted that the maximum overall diameter of this stranded conductor is actually equal to three times the diameter of an individual strand. The circle circumscribing the stranding in the above diagram shows this.

In column 6 of the table the asterisk in the column heading calls attention to the fact that this area is the area of the circumscribing circle, rather than that of the total cross sectional areas of the strands. Column 5 should actually have a similar note calling attention to the fact that it is the diameter of this circumscribing circle. This diameter

is, therefore, equal to 3 x the diameter of an individual strand, or 3 x .0612 = .1836 inches.

This checks the value of .184 shown in column 8.

For a 61 strand conductor, a similar diagram will show that the diameter of the circumscribing circle will be equal to 9 times the diameter of an individual strand. For the 1000 MCM conductor the calculated diameter is 9 x .128 = 1.152 inches, which checks exactly the value shown in column 5. —B.Z.S.

Conductors

Q. *We plan to run four different sets of motor circuit conductors through a wireway. Inasmuch as there will be 12 current carrying conductors, is it necessary that their current carrying capacity be derated as they are all within the same raceway? One of the engineers with whom we have consulted insists this is essential to assure a safe operation, yet the National Electrical Code does not require derating as we read it.—H.B.*

A. You are correct in your assumption that Section 3624 of the Code does not require derating of conductors contained within a wireway. However, actual field experience has indicated that unless such conductors are derated, faults may be anticipated whenever such conductors are expected to carry near their regular rated capacity. The reasons for derating the carrying capacity of a conductor in a conduit or in a cable is simply because of the inability of the conductor to dissipate its heat properly. Certainly it is just as big a problem for heat dissipation from a bundle of conductors in the bottom of a wireway as it is from a bundle of conductors contained within a cable or conduit and therefore even though the Code does not as yet require the derating of conductors within a wireway, I strongly recommend such practice be followed unless the conductors are carried on racks so some separation may be assured to facilitate easy dissipation of heat given off.—G.R.

Recessed Lighting Fixtures

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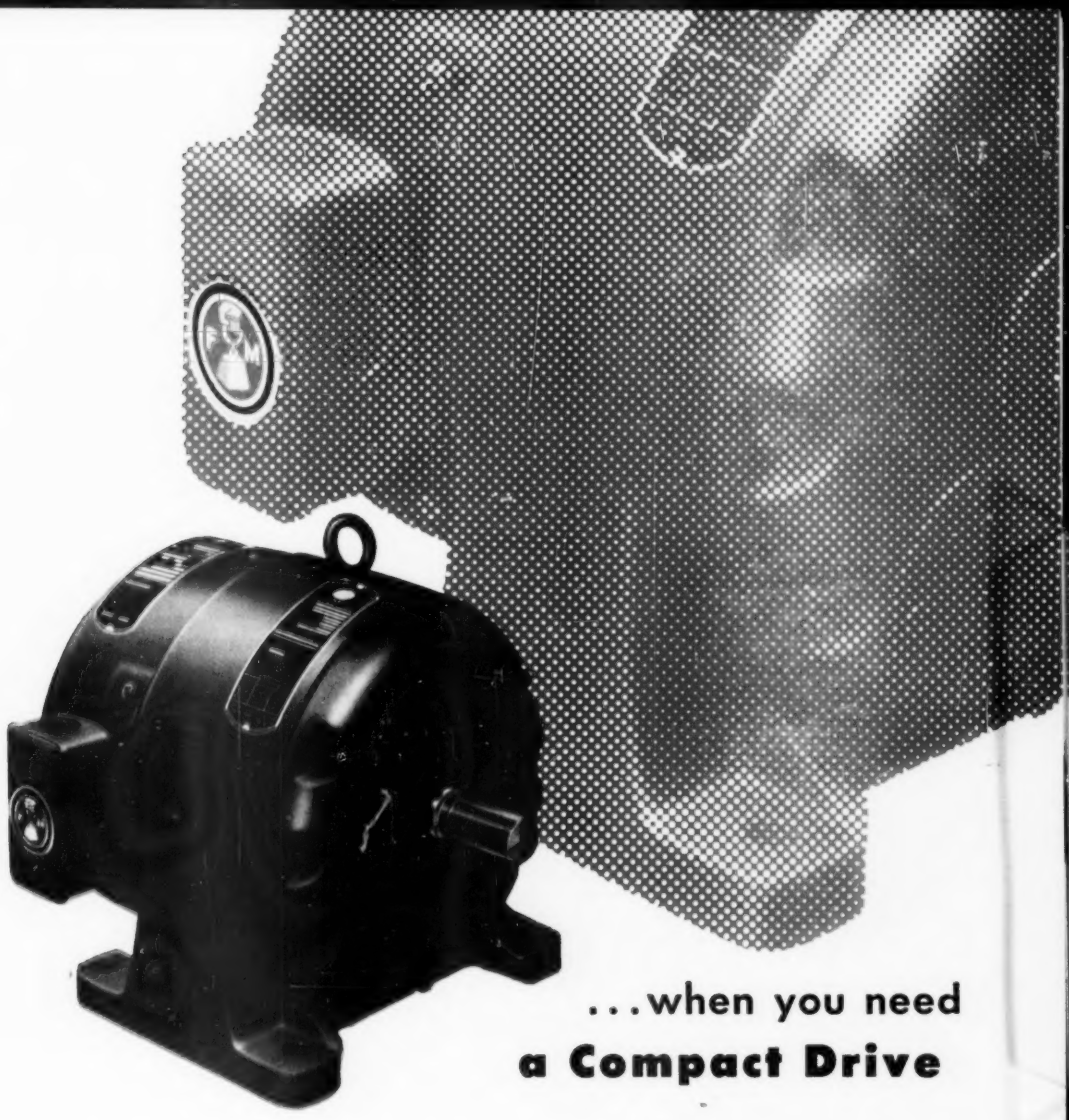
be installed by running cable direct to the outlet box attached to the outside and opening into the fixture. These fixtures are no doubt approved by the N.B.F.U. but the way we interpret Article 410, Section 4179 a & b an additional junction box is needed where the temperature is indicated as being above 60°C. Are we correct in this interpretation?—H.G.H.

A. Section 4179 definitely requires recessed fixtures to be served with conductors whose insulation is suitable for the temperatures involved when such temperatures are higher than 60°C (140°F). Section 4122 also is involved since it requires conductor insulation at fixture outlet boxes to be approved for the temperatures encountered. As you indicate in your question, the big question for the Inspector to decide concerns the fixture and its operating temperature especially when it exceeds 60° C. You will note from the rule however, that the Code recognizes the fact that some recessed fixtures may operate at temperatures of 60°C or lower. The Underwriters' Laboratories helps the Inspector to decide this question. A U. L. approved recessed fixture will carry a U. L. Label and the fixture will be marked when the temperature exceeds 60°C. This U. L. requirement reads as follows:

"Recessed fixtures which attain temperatures exceeding 60°C (140°F) at the point where supply connections are to be made are marked at the point of supply connection to indicate the temperatures for which supply conductors are to be suitable. The absence of such marking indicates that 60°C (140°F) supply conductors are suitable". (See page 97 of the 1952 U. L. Electrical Equipment List). This provision should be of great assistance to the Inspector in determining the question. It appears to me however, that all such fixtures should be marked even when they operate at temperatures of 60°C or below. In the event of any unusual conditions, I believe a temperature test should be made at the outlet under actual operating conditions. A few such tests would, I am sure, assure the Inspector that the Code is or is not satisfied.

In view of the foregoing, you are correct in your opinion that the additional box as required by Section 4179-b is needed to satisfy the Code when temperatures greater than 60°C are involved. Another approved method is covered by Section 4179-a which recognizes conductors with suitable insulation to be run direct to the fixture. The fact remains, that some recessed fixtures may operate at temperatures of 60°C or less.—B.A.McD.



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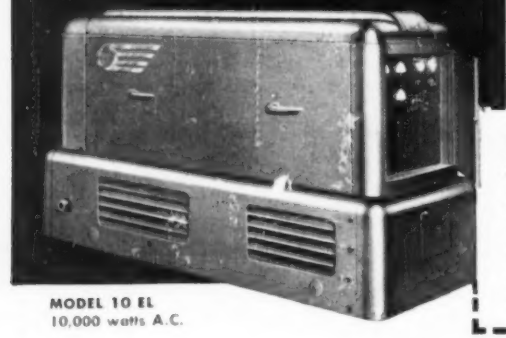

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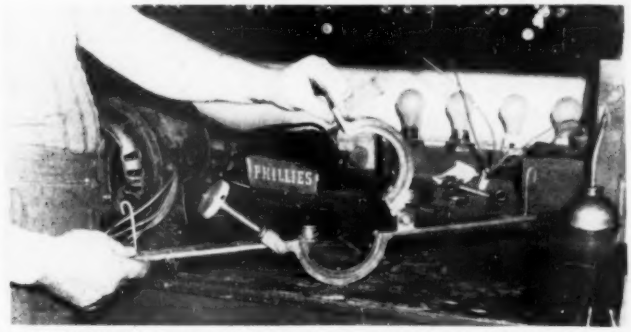


PRONY BRAKE is constructed from two pices of strap steel, each with a semi-circular lined bend. Pieces are hinged on one side and locked in a closed position with a hook-over clamp and adjustable pressure bolt.

Prony Brake For Torque Testing

A simply constructed prony brake, made by Hallett Fleck, Fleck Electric Motor Repair Service, Norristown, Pa., simplifies the job of finding the torque in pound feet of reconditioned motors.

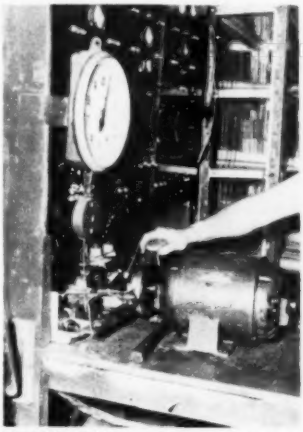
The brake is constructed of 1-inch strap steel. The main piece is two feet long and has a 2½-inch semi-circular bend in the middle. Another piece of strap steel, also in a 2½-inch bend, completes a circle with the first piece. The second piece is attached to the main section with a hinge at one end, the two pieces forming a complete circle when closed over. Both curved sections of strap steel have brake lining attached to their inner surfaces. The braking material is regular automobile brake lining which has been cut to size to fit the semi-circular bends.

An adjustable screw and hook-over clamp are attached to the main section of the brake to hold the second piece in position. By turning the screw knob, pressure is applied to the brake assembly when it is in testing position around a pulley wheel mounted on the motor shaft.

When a motor is to be tested, a pulley wheel is first placed on the motor shaft, and the prony brake assembly is clamped over the wheel circumference. The end of the brake arm is hooked to a hanger from a pound scale which is used to measure the test results. With the motor running, the adjustable pressure bolt is taken up to increase the friction between the rotating pulley wheel and the brake lining. The torque of the running machine is then readily determined as the product of the pound force indicated by the scale reading and the length of the brake arm from the hook to the scale to the center of the motor shaft. If necessary, the torque, which is in pound feet, can be converted to hp by the following formula:

$$HP = \frac{6.28 \times rpm \times TORQUE\ (pound\ feet)}{33{,}000}$$

Although the results of this type of test would not be extremely accurate, they would be sufficient to assure a reasonable measure of motor output.



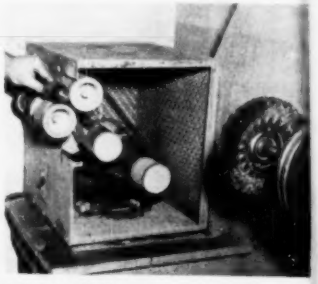
TORQUE TEST is made with the brake clamped over a pulley wheel on the motor shaft and with the end of the brake arm hooked to a pound scale. Torque in pound feet equals the scale reading in pounds times the distance between the brake end and the center of the motor shaft.

Sander Smooths Armature Surfaces

A double drum sander has been constructed by Albertson & Son, Philadelphia, which removes the hard varnish from the surface of the core after it has been completely baked. This sanding process is necessary, because it's hard to finish up armatures that have a hard surface, in addition to closing up or just making a small clearance between the armatures and the field. Instead of sanding or scrapping by hand, this electrically powered double sander does the job in a few seconds.

A ¼-hp motor powers the shaft that rotates the wheels on which the continuous sander belt is placed. The two leading rollers turn in opposite directions, so that when the employee holds the armature to them, the armature rotates while sanding.

A 20 inch by 18 inch by 16 inch metal housing is used for the motor and the rollers.



BELT SANDER is motor-driven by center shaft, while sanding belt rotates around the other three pulleys clockwise. Armature is also rotated clockwise over the double-drum pulleys, as shown, to smooth the baked varnish surfaces on the core.

Rotating Brushes Wipe Tinned Coil Leads

Wiping excess tin from the leads of coils is accomplished in the shop of the Warwood Armature Repair Company, Wheeling, W. Va., by means of a pair of bristle (not wire) brushes that rotate at high speed. Since the brushes are relatively soft, the tinned ends are not scratched and the tin coating is not damaged, yet the wiping operation is fast and positive, and the

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COIL LEADS are wiped of excess tin after dipping, by a pair of rotating brushes that rotate in opposite directions with the inner bristles moving towards the rear where a backing of waste material catches the residual tin.

usual method of wiping the ends with sleeving or rags is unnecessary.

The two brushes rotate towards each other so the operator can easily place the surfaces against the two brushes by merely raising and lowering the coil leads. A backing of waste material is placed behind the brushes to catch the particles of excess tin which are thrown backwards by the centrifugal force of the rotating wheels.

Metal-Spray Wire-Rack Formed From Angles

A wire rack keeps wire used for metal spraying off the floor yet within easy reach of employees of George Lockwood's motor repair shop in Trenton, N. J. The rack, simply con-

EYE INVENTORY of stock quickly indicates when various sizes of wire require reordering. Frame is constructed from angle irons.

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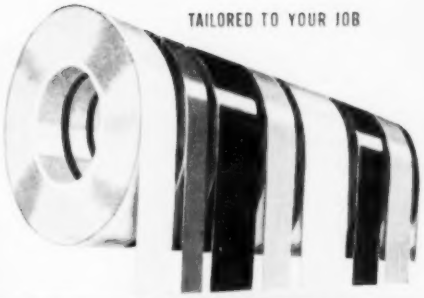

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Ask your Westinghouse representative about other reasons—all steel construction and greater electrical strength. And ask for a free copy of "Facts on Pre-Lubricated Bearings" (B-4378), or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21705-A

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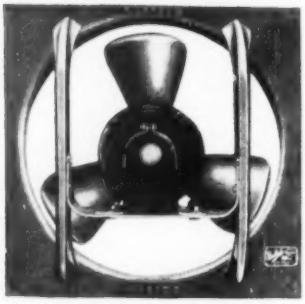

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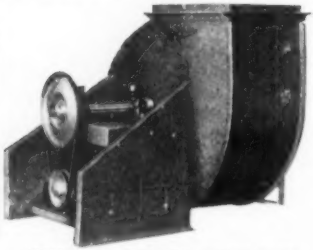

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structed from angle iron, extends 2-feet out from the wall and measures 4-feet in length. It is attached to the wall by several angle iron supports which also serve as space-dividing coil-supporting barriers. Various sizes of wire are carried in labeled spaces and, because of its location, the contents of the rack can be inventoried visually for re-ordering purposes, eliminating shortages and lost time.

Previously, when reels rested on the floor, men had to fumble through the pile to select the proper size and tripping was not uncommon.

Gauge Insures Uniform Wedge Lengths

A regular band saw has been equipped with a measuring gauge on the leading or feed side of the band saw table. This helps employees cut off wedges to the proper lengths according to their needs on the armatures being rewound.

"We bundle the lengths of wedges together, then place them on the band saw table," says Al Albertson, owner, Albertson & Son, Philadelphia. "We then measure them off for proper lengths on the attached gauge and the band saw cuts them all off to proper lengths at one time.

"Before we had this gauge attached to the band saw, we used to cut the wedges to size from individual wedge sticks. This meant that the employee had to make ten cuts, if he needed ten wedges. With our current arrangement, he just bundles the proper size wedges together and with one cut

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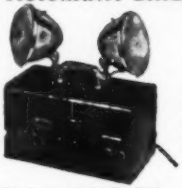

Big Beam Model 2-ATW with storage battery and built-in charger that keeps battery fully charged at all times.

Whenever storms, fires, floods, or accidents disrupt lighting service, a Big Beam automatic emergency light will provide illumination for hours. Sudden blackouts breed confusion, panic, property damage, bodily injury—even death—wherever groups congregate or essential operations must continue.

Maximum protection is easy with a Big Beam emergency light. No special wiring is needed—just place the unit for best illumination and plug into convenient lighting outlet. *Dry-cell models and self-charging storage battery models to meet all state codes.*

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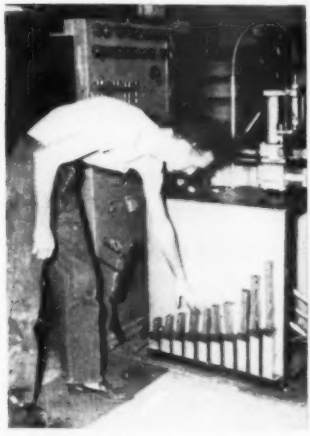
"In addition to reducing time and effort in this job, we are sure that all the wedges are cut identically the same."

Square Pockets Hold Press Plates

Plates for the coil press in use at Lockwood's motor repair shop in Trenton, N. J., are conveniently stored in a rack mounted directly to the press stand. To a sheet of thin metal plate, Lockwood welded a series of 2-inch square channel sections, closed at the bottom to prevent press plates from slipping through to the floor of the shop.



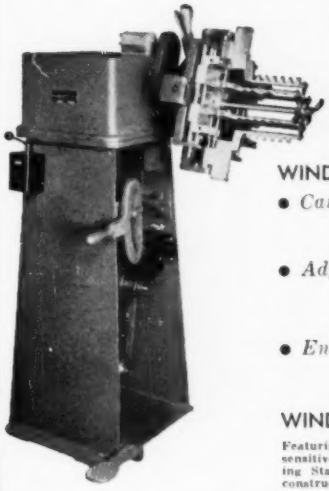
PLATES PROTRUDE from pockets about half their length, speeding selection and replacement. Mounted directly to the coil press stand keeps plates ever handy for use and constantly accounted for.

On the outside of each square container is a metal plate identifying the size of the unit to be stored, and pockets are made about half as deep as the plates to be held, running in length from about 6- to 12-inches. Since plates stick out approximately half their length, it is easy for employees to quickly withdraw or replace items.

Enclosed Lye Tank Has Practical Features

Degreasing and cleaning by means of a lye solution is carried on in a safely segregated tank in the shop of H. N. Crowder Jr., Allentown, Pa.

The sheet steel tank, equipped with a bottom drain, is mounted above a gas-fired heater which is enclosed by a



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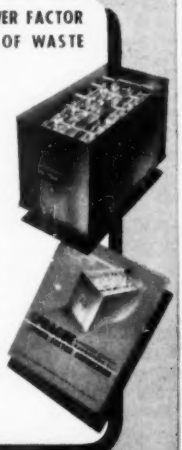
Most inductive electrical equipment installed in a plant wastes money, money that *can be saved*. Some of it goes to supply non-productive magnetizing current. More of it goes to buy extra wiring, switches, and transformers to make up for this loss. Still more is wasted in reduced output through lost load. These wasted dollars can be saved by installing Sprague Power Factor Correction Capacitors at each piece of inductive electrical equipment. Write for free cost-saving guide, "Power Factor Correction" today.



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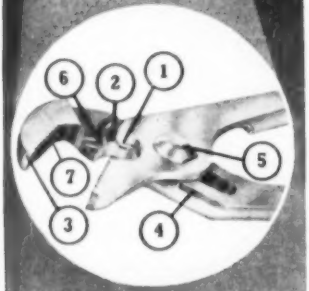

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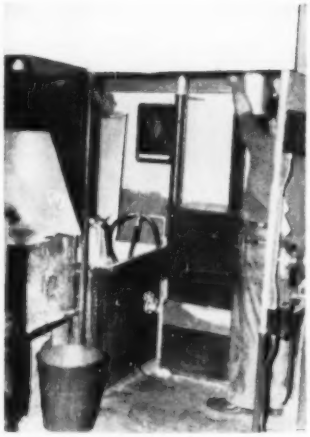

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metal shield, perforated to permit the free entrance of air to the burners. This assembly—tank and enclosed heater—measures approximately 30 inches in height; 30 by 18 inches in plan.

Heat and fumes are removed through a 4-inch vent pipe which rises from the center of the tank cover. This vent, in turn, fits under a second vent which is larger in diameter and which can be raised or lowered by means of handles bolted to the sides of the movable section. With this arrangement, the upper vent can be raised when the tank cover is being removed or placed in position, and it may be lowered to fit around the upper extremity of the 4-inch at all other times.

An adjacent sink provides facilities for rinsing the lye-cleaned units as soon as they are removed from the tank.

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A combination counter and automatic clutch type foot brake has been attached to the winding heads at Albertson & Son, Philadelphia. The counter helps the winders keep track of the turns and the handy foot brake permits them to stop the winder at any time.

"The counter has been attached so that it works in coordination with the winding head," says Albertson. "It is connected by means of a pulley that rotates the counter one full number with every full turn of the head. The handy foot brake makes our winding

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KEEPING COUNT of the number of turns on the head of a winding machine is done by a combination counter and clutch-type foot brake attached to the machine at Albertson & Son's shop, Philadelphia, Pa.

operations simple and our employees do not have to keep track of the number of coil turns in their heads. They can always see the number on the counter."

"WANT PADS", attached adjacent to stock bins in the motor repair shop of Charles Buckley, Atlantic City, N. J., are the basis for a simple perpetual-inventory system which insures the maintenance of an adequate stock of repair and replacement parts. When items are observed to be in short supply, employees jot down this fact on the pad and, at the end of each week, the top sheet of the pad is removed and the items noted thereon are re-ordered. Prior to the adoption of this system, periodic inspections were time-consuming and sometimes subject to error. The new want-pad system has proved entirely satisfactory with a negligible amount of time consumed.

MARCUS DRY TYPE transformers

first with Dry Type, Pole Mounted Transformers

first with *Quinterra* Insulation

NOW... *first*

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Nothing is ever considered so good at Marcus that improvement isn't searched for constantly. Since insulation is the heart and backbone of any transformer, Marcus is proud to announce its use of the first real advancement in Class B insulated magnet wire in 12 years. The combination of Johns-Manville *Quinterra* with DuPont *Mylar* and *Dacron* not only provides exceptional heat resistance but dielectric strength as high as 10 times that of the present industry standard. Failure at such vulnerable points as turn-to-turn and layer-to-layer becomes a virtual impossibility. Moreover, another Marcus first, *Quinglas*, having unusually high physical strength, adds extra protection between layers.

Insulation levels never thought possible or economical with dry type transformers are now available from Marcus, one of the largest manufacturers in the world of dry type transformers exclusively. Capacities from 1 to 3000 KVA, up to 15,000 volts.

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"G-E Remote-Control Wiring goes in with real speed at low cost"

. . . says Clyde Grubb of Globe Electric, Dallas

"When the James A. Crow Company, Dallas, asked for wiring bids on their houses at Lake Park Estates, one of the features was G-E remote-control," said Clyde Grubb, Globe Electric. "When I figured costs for the bid, I was surprised to discover that remote-control wiring can be installed economically.

"Globe Electric got the contract for $50 per house more than we usually bid on a conventional wiring job for houses in this price range," said Mr. Grubb. "These houses sell for $25,000 to $40,000.

"As my men became familiar with remote-control wiring," Mr. Grubb continued, "I was more than pleased to find them making real speed. It didn't take them long. The lightweight control wire for the switches can be stapled to the framing," said Mr. Grubb. "This helps make the work go fast and keeps costs down to a very reasonable figure." He concluded, "I'd say G-E remote-control goes in with real speed and at a surprising low cost."

"G-E Remote Control Wiring helped me sell $2,000,000 in homes"

"We added a real selling tool to our Lake Park Estates project in Dallas when we decided on G-E remote-control," says builder James D. Crow of James A. Crow and Company. "We've featured remote-control in our advertising and made it a part of our selling program. Most important, our home buyers are completely sold on G-E remote-control," concludes Mr. Crow.

WHAT G-E REMOTE CONTROL IS

G-E remote control is the low-voltage modern wiring system that permits you to have as many ON-OFF controls of any light or outlet as you wish . . . including master switches, each of which will turn ON or OFF nine lights or outlets from one location. It adds convenience and safety . . . is economical for residential or commercial buildings.

Contractors Manual—Thirty-six page manual gives you all the facts—layout, wiring diagrams, and important installation hints. See your Construction Materials distributor, or write Section D44-1218, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

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GENERAL ELECTRIC

In The News

N.F.E.C. Lists Farm Wiring Problems

Rapid strides have been made during the past decade in the electrification of the nation's farms—both the farm home and production buildings. Among states reaching saturation is Michigan with power available to about 99% of its farms. Mechanized farming has increased agricultural production per man-hour 35% from 1940 to 1951 compared to an 11% gain per man-hour in industrial production. Research and experimental groups are constantly finding more use for electrical equipment on today's farms. Facts such as these were pointed up at the two-day Seventh National Farm Electrification Conference recently held at the Hotel Statler in Detroit.

These are gains, which can be entered on the credit side of the farm electrification ledger. Still on the debit side are numerous farm wiring problems for which satisfactory solution commands the cooperation of the entire electrical industry. A conference panel session listed the following as the five "toughest" problems of farm wiring today:

1. How can the farmer anticipate future load requirements and wire for same?

2. How can electrical contractors be kept from unselling the farmer on an adequate wiring job?

3. How can wire be procured for farm wiring?

4. How can inadequate farm electrical systems be brought up to capacity?

5. How can electrical inspection be brought to farm areas?

Members of the panel who led the discussion were Vernor Smith, Wolverine Electric Cooperative, Big Rapids, Mich.; F. J. Groleau, NECA, Washington, D. C.; and H. E. Kapphahn, supervisor, REA Safety and Job Training, Michigan State College, East Lansing.

While no specific recommendations were made at the all-too-brief forum, the general concensus was that a cooperative and concerted educational program is badly needed. The farmer must be advised as to what there is in the way of electrical equipment and applications that can help him do a better job; as to the need for safety and inspection of electrical installations. He must demand these things for his own benefit and safety. Then there would be little chance for a local contractor to unsell a good wiring job, or for an installation to go uninspected. Among the suggestions made: Contractors and power suppliers should survey farms and make recommended layouts; farm service facilities should be installed to take care of a 100% to 200% increase in load.

FARM WIRING PANEL at recent National Farm Electrification Conference in Detroit included: (L to R) F. J. Groleau, NECA, Washington, D. C.; Vernor Smith, Wolverine Electric Cooperative, Big Rapids, Mich.; H. E. Kapphahn, Michigan State College, East Lansing; and Dawson Womeldorff, Public Service Co. of Northern Illinois, Chicago.

Not only the farmer, but the electrical contractor, dealer and inspector are in need of education on farm wiring requirements. Floor discussion pointed out that the National Electrical Code, of necessity, is not developed around farm wiring and inspectors find it difficult to interpret code rules as applied to farm installations. More education of inspectors in rural areas on applicable Code sections is needed.

Following the forum period, R. T. Jones, Pennsylvania Power and Light Company, Allentown, Pa., scored the utilities for not having a concerted effort to bring electrical information to the farm youth. Better trained staffs are needed to help sell electricity to the farmer. S. Riggs Shepperd, assistant administrator, REA, Washington, D. C., outlined the REA Electric Farming Program, an educational campaign designed to stimulate increased production, through effective use of power, on the farms of cooperative members. Key to the campaign is enlisting the help of every interested organization in a coordinated program, he revealed. What the private utilities expect to do along these lines, was outlined by E. D. Smith, chairman, farm section, Edison Electric Institute. EEI's farm program includes teaching aids, an Engineer's Handbook on Farm Electrification and a Farm Electrification Manual with newly developed sections, he noted.

Once these educational programs begin to bear fruit, and the stated problems are minimized, the road to attainment of the conference theme-goal "Wired Men—Not Hired Men" could become an expressway to increased efficiency, more leisure and more profit for America's farm population, and more business for the electrical contractor.

There will be no Farm Electrification Conference next year. That was the recommendation of the conference steering committee at the final session. The committee will remain intact and use the interim period to reevaluate certain aspects of the conference and to bring into sharper focus the objectives of the group.

Lighting Symposium Held In Washington

An all-day symposium on advanced lighting applications was held in Washington, D. C., recently. Sponsored jointly by the Capital Section of the Illuminating Engineering Society and the Electric Institute of Washington, it was attended by 110 registrants—electrical contractors, engineers, architects, lighting equipment and wholesalers' salesmen, utility lighting engineers and others.

R. G. Slauer, Sylvania Electric Products Inc. of Salem, Mass., presented many new ideas in his talk on "Trends in Lighting Practice."

Mr. Slauer outlined lighting practice trends historically, dividing them into two fields—industrial and commercial.

Five outstanding trends in industrial lighting were named, as follows: 1) the RLM reflector in 1920—first coordination of the lamp and reflector; 2) low brightness units in 1935—large area lighthood units using the incandescent lamp; 3) the fluorescent lamp in 1938—a lamp with new characteristics, low in brightness, high in efficiency, all in the right direction for improved lighting results; 4) continuous rows of light, 1940—in which the

linear fixtures follow the need for lighting; and 5) high quality lighting, 1951—in which some upward component of light is used to improve the lighting environment.

Outstanding commercial lighting developments were named as follows: 1) indirect lighting in 1910, in which the lighting was "engineered"; 2) silver bowl lamps in 1930; 3) efforts to reduce ceiling brightness in 1936; 4) continuous row fluorescent, 1940—in which the troffer was introduced as a distinct type of lighting wherein the luminaire is not a part of the room; 5) overall ceilings, 1948; and 6) combination of lighting system with acoustical treatment, in 1951.

Acrylic Plastics for Illumination was the subject of a talk by H. A. Williams of the Rohm & Haas Co. of Philadelphia. Mr. Williams pointed out that there are many types of plastics, each with different properties, and proceeded to show why acrylic plastic is desirable for lighting purposes. He then outlined the procedure for estimating the lighting intensity for a luminous ceiling, using the lumen method for general lighting design as given in the IES Lighting Handbook.

Bob Dorsey of General Electric Co., Lamp Department, Nela Park, demonstrated "Light for Selling—Stores," using stage models and props. He showed visually by the models the need for general lighting, display and accent lighting, and how to use color effectively for maximum display results.

Edward Rambusch of Rambusch Decorating Co., New York, discussed the unusual problems encountered in architectural lighting, presenting in detail the many fine points of church lighting.

Light for seeing in schools and offices was presented by John Neidhart, Westinghouse Electric Corp., Cleveland. Mr. Neidhart first showed by means of slides a series of laboratory experiments in which various luminaire designs were tested to determine if they would meet the requirements of the IES-ASA specifications for luminaires for school classroom lighting.

Then Mr. Neidhart showed the results of a comparative cost study made to determine the "relative annual cost per footcandle" for nine different lighting systems for a 24-ft. by 30-ft. room with a 12-ft. high ceiling. These lighting systems were based on the use of both incandescent and fluorescent lamps, and on intensities ranging from 25 to 52 footcandles.

The program chairman was Claude Engle, vice-chairman of the Capital Section, IES and engineer with General Engineering Associates, Washington, D. C.

Cogan Is New IAEI Technical Assistant

Everett F. Cogan of New Orleans is the new technical assistant secretary of the International Association of Electrical Inspectors, Inc. He assumed his new duties in the Association's Chicago headquarters Nov. 17, replacing Robert A. Peterson who resigned this past summer.

Mr. Cogan brings to his new post a long and varied career in the electrical industry. He is a graduate of the University of Detroit with a bachelor of science degree in electrical engineering and has taken post-graduate courses in various colleges and universities in the South.

EVERETT F. COGAN

Since 1948 he was employed as an electrical engineer and inspector by the Louisiana Rating and Fire Prevention Bureau. Prior to that he was an electrical inspector for the City of New Orleans. During the war Mr. Cogan was with the War Assets Administration, U. S. Navy Bureau of Ships, Consolidated Vultee Aircraft Corporation. From 1935 to 1940 he was a general electrician with the Southern Pacific Railroad.

NECA Asks AGC to Submit a Plan

The National Electrical Contractors Association has suggested to the Associated General Contractors of America that if it can develop a practical proposal for the correction of monopolistic and unfair trade practices in the construction industry that it submit it to NECA for consideration in writing. Until that is done, NECA can see no point in establishing a joint "cooperative committee" to explore industry relationships.

In a letter to the AGC, President D. B. Clayton, Sr., president of NECA, summarized the results of a conference between a special NECA Committee and a special AGC Committee held in Washington on November 11. At that meeting the NECA Committee submitted its plan to eliminate bid peddling and bid shopping and abuses in cost-plus contracting on federal public works. The AGC Committee had no plan but wanted to create a "joint cooperative committee" to study the situation.

The NECA plan is based on inducing the customers of the construction industry to adopt the use of a fair bidding practice procedure in their construction contract awards. To approach the largest customer first, NECA asked the AGC to join with it and other national associations of mechanical specialty contractors in drafting and recommending to Congress legislation requiring federal constructing agencies to observe contracting procedures designed to prevent bid shopping and bid peddling in connection with lump sum contracts and wasteful and monopolistic awards in connection with cost-plus-fee contracts.

The AGC Committee refused to join in such an effort although it agreed that bid shopping and bid peddling was an unfair trade practice and should be eliminated, and also that it is a wasteful and unsound practice for prime construction contractors on cost-plus-fee construction contracts to undertake the performance of mechanical specialty work unless the prime contractor has an established successful performance record in those fields.

McGraw Award to Late W. C. Johnson

A posthumous award to the late William C. Johnson, former president of the National Electrical Manufacturers Association and executive vice president of Allis-Chalmers Manufacturing Co., was voted by the Committee of Awards, James H. McGraw Award, upon the recommendation of the Committee of Judges for the 1952 Manufacturers Medal and Purse.

The award was presented by Curtis W. McGraw, president of the McGraw-Hill Publishing Company, acting for the Committee of Awards, at the NEMA convention in Atlantic City on November 11. W. A. Roberts, president of Allis-Chalmers Manufac-

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turing Company, accepted the award for Mr. Johnson's family.

The award was voted to Mr. Johnson for his great personal efforts toward establishing the economic and social purposes and benefits of voluntary engineering standards which have contributed to the advancement of the electrical manufacturing industry.

The judges were J. K. Johnston (deceased), National Vulcanized Fibre Co.; B. A. Neece, Landers, Frary & Clark; R. M. Casper, Allis-Chalmers Mfg. Co.; J. M. Bennan, Jefferson Electric Co.; J. H. Jewell, Westinghouse Electric Corp.; and W. T. Stuart for the Committee of Awards.

Plant Maintenance Program Completed

The most comprehensive Maintenance Conference yet presented is scheduled for Cleveland's Public Auditorium January 19-22. Jointly sponsored by the American Society of Mechanical Engineers and the Society for the Advancement of Management, the conference will include 66 separate sessions, covering 42 round table discussions, 16 sectional conferences, 4 plant tours, 3 panels and a banquet. Major emphasis will be on open forum question-and-answer sessions, and many of the discussions have been scheduled as 2-day sessions to encourage visitors to consider initial presentations overnight before submitting questions based on their own experience. Subject matter will be segregated into separate sessions, dictated by peculiarities of different industries

BLACKBOARD SESSION on subject of add-on type circuit breakers is led by G. O. Wilson, chief electrical inspector, Rock Island, Ill. Interested group includes: (L to R) M. R. Soth, WESCO, Davenport, Iowa; L. C. Neumann, Underwriters Laboratories, Chicago; and C. A. Wingfield, Commonwealth Edison Co., Chicago.

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and different sized plants. The unique arrangement of the program is expected to stimulate analysis of 5000 or more individual maintenance problems.

Scheduled to run concurrently in the same auditorium is the Plant Maintenance Show, in which approximately 300 manufacturers, represented by 1500 engineers and salesmen, will present 7000 products associated with the maintenance field.

Of particular interest to electrical men are general conference sessions on maintenance essentials such as planning, scheduling, budgeting, training, operating policies and methods. Maintenance of electrical equipment will also be discussed in one of the sectional conferences, as will be the maintenance of power plant equipment. So that visitors to the conference may select the sessions treating problems of specific interest to them, problems have been divided into plants having fewer than 50 maintenance employees, 51 to 100, 101 to 300, 301 to 800, and over 800. Still other topics with appeal to the electrical delegate are Lighting, Area vs Centralized Maintenance, Dealing with Union Labor, Incentives and Work Measurement, Selling Management on the Maintenance Program, Maintenance Stores and Growing-pains of an Engineering-Maintenance Organization.

General chairman for the conference is L. C. Morrow, consulting editor, *Factory Management and Maintenance*. Management of the exposition is by Clapp & Poliak, New York City.

NISA News

The New England Chapter's regular meeting was held at the Hotel Bradford, October 9th and President Harry Bedig presided. There were 45 members and guests present. The minutes of the previous meeting were read and accepted. Also the secretary's and treasurer's reports.

Membership committee reported two new members, the Clinton Motor Service Co. and the Commercial Motor Service Co. The membership of these companies was unanimously approved.

Speaker for the evening was Mr. Innis of Sylvania Co. who gave an interesting talk on the past, present and future of industrial, commercial and home lighting.

• • • •

The Los Angeles Chapter held their meeting Election Night, October 14th, with 34 in attendance. Meeting was called to order by Chairman Hogue.

Chairman Hogue then gave the report of the nominating committee which was headed by William Hill of Hill Electric; nominations were also asked from the floor. Nominations presented by the committee were accepted for the year 1952-53 and they are: Chairman, E. Sweinhart, Sweinhart Electric Co., Los Angeles; Vice-Chairman, William Pompey, Pompey Electric Co., Pasadena; Re-elected Secretary, Cecil Leach, Commercial Electric Motors, Alhambra; Treasurer, Russell Lockard, Lockard Motor and Pump Co., Los Angeles; the 5th member for committee work, Lloyd Mokkler of Zamboni Brothers, Paramount, Calif.

Chairman Hogue turned the gavel over to the new chairman for the balance of the evening. Chairman Sweinhart called on Vice-Chairman Pompey to carry on the educational part of the meeting. Pompey called on Howard Williams of Alexander-Williams, who spoke on Customer Relationship. The next speaker was Herb Magney of Magney Electric Pump Motors. The third speaker was C. F. Backstrand of Riverside, on Deep Well Pump Motors. The fourth speaker was Walter Suhre of Hill Electric, who spoke on the handling of fractional hp motors.

• • • •

The new Cleveland Chapter held its meeting on Monday, October 27th, at Cleveland Hotel, with temporary Chairman Lee Ruppersberg presiding. Lee read some correspondence from Selden High and Meyer Friedkin pertaining to the importance of the Cleveland Chapter becoming active. Ed Potter of Lima Armature, a national board member, was present and made some further remarks toward that end. The question was raised as to whether the Cleveland Chapter would be interested in a display booth at the Plant Maintenance Show. After discussion, a resolution to the effect was made seconded and carried unanimously.

EASTCOAST DELEGATES from the land of the Yankees and Dodgers included Louis Freund, Louis Freund Elec. Constr., New York City, and S. M. Shor, Empire Switchboard, Brooklyn, who talked baseball and business at the NECA Convention.

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The following committee was named to handle the necessary details—F. Allen of Elliott Electric, Warren Fowler of Reserve Electric and Ed Margolis of the Motor Repair and Mfg. Co.

A nominating committee was appointed consisting of Milt Meyers of Commercial Electric, Al Graham of Arrow Electric and S. Spector, Electric Generator and Motor Repairs. They were asked to report at the next meeting.

• • • •

Special identification badges have been sent to the 18 living past-presidents of NISA and to Mrs. Katie Brown, widow of Alfred L. Brown, president of the Association, 1942-43. The attractive gold badges were designed to serve as identification badges during NISA meetings.

• • • •

Central District Chapter, Chicago, held its first fall meeting September 9th at the Electric Club with the largest attendance in several months to hear a management procedure panel consisting of representatives from Excel Electric Service Co., Hyre Electric Co., Northwestern Electric Co. and Sievert Electric Co., all of Chicago.

• • • •

The first fall meeting of the Great Lakes Chapter was held at Grand Rapids, Michigan, September 15th at the Kirkhof Electric Co., and was co-sponsored by Clement Electric Co. Detroit members chartered a bus for the trip, stopping at Lansing, Michigan, on the way to tour the shop of the Barker Fowler Electric Co.

• • • •

Quaker City Chapter met September 10th at Beck's on the Boulevard, Philadelphia. Among regular business discussed was a proposal for the chapter's membership committee to devote extra time to visiting non-member shops in the area.

• • • •

The regular meeting of the New York Metropolitan Chapter was held at the Shelburne Hotel, October 16th, and A. Shovan presided. L. D. Kennedy read minutes of the previous meeting, H. Englemann read the treasurer's report which was followed by the report of S. Bojak on progress made by the membership committee.

W. L. Hirshberg of Spencer Thermostat Division of Metal & Control Corporation, presented a talk on the subject of motor protection. A very lively discussion followed.

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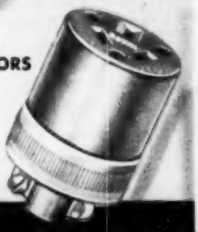

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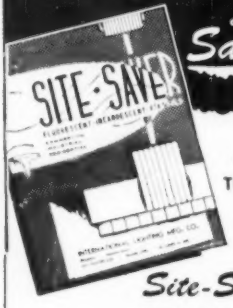

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GENERAL CHAIRMAN of the IAEI Silver Jubilee Convention Committee, S. R. Todd, Chicago, urges inspector groups to fatten their piggy banks for the big 1953 conclave.

McGraw Award Committee Men Named

Four additional electrical industry members were elected to the permanent Committee of Awards, James H. McGraw Award for Electrical Men. The new members, one from each major branch of the industry, are: H. A. Webster, president, T. Frederick Jackson, Inc., H. P. Thuerk, president, New Jersey Power & Light Co., R. S. Edwards, president, Edwards Company, Inc. and E. B. Ingraham, president, Times Appliance Co.

The new members join with the present members—L. K. Comstock, H. P. Liversidge, C. E. Swartzbaugh, A. H. Nicoll, W. T. Stuart and Alice McMullen—in reviewing recommendations for the Award and administering the activities of the Committee.

Among the Manufacturers

Headquarters Announcements

Bryant Electric Company, Bridgeport, Conn.—Owen L. Taylor, manager of engineering.

Pryne-Rittenhouse Sales Corp., Pomona, Calif.—national sales organization of the Rittenhouse Co., Inc., and Pryne & Company, Inc.

General Electric Company, Morrison, Ill.—Richard D. Tyler, manager of marketing, and Thomas J. Kelly, manager of engineering, for the appliance control department.

Sylvania Electric Products Inc., Ipswich, Mass.—Cyrus Stonehill, sales manager of new ballast department.

General Controls Company, Skokie, Ill.—R. C. Boehm, assistant manager for the appliance and heating divisions.

Cutler-Hammer, Inc., Milwaukee, Wis.—K. M. Nelson, division manager for industrial control sales; M. R. Brice, division manager for industrial control sales; G. A. Rauch, division manager for distributor sales.

Rohm & Haas Company, Philadelphia, Pa.—Donald F. Murphy, vice-president.

Ramset Div., Olin Industries, Inc., Cleveland, Ohio.—A. L. Fabens, Jr., assistant general manager and production manager.

Morrison Steel Products, Inc., Carry-All Div., Buffalo, N. Y.—Leonard H. Schwartz, factory representative for the United States.

Regional Appointments

NEW ENGLAND

Westinghouse Electric Corp.: Alfred E. Lambert, Jr., manager of distribution apparatus sales for New England.

MIDDLE ATLANTIC

General Controls Company: Russell Strongman, regional sales manager for branch offices in Newark, New York, Hartford and Boston.

BullDog Electric Products Company: John J. Carr and Charles F. Foster, Philadelphia, Pa., sales force.

EAST CENTRAL

Pyle-National Company: George R. Adams, district representative in new sales office in Milwaukee, Wis.

General Electric Company: Frederick F. Denny, manager of the Lamp Division's midland sales district in Chicago headquarters.

Pittsburgh Reflector Company: William J. Fetzer, lighting representative for the Columbus-Cincinnati-Louisville territory, headquarters in Cincinnati.

Mitchell Manufacturing Company: William I. Crockett, Wisconsin district sales manager for commercial and industrial fluorescent lighting.

General Controls Company: B. L. Lerch, regional manager for the Mid-West.

WEST CENTRAL

Morrison Steel Products, Inc., Carry-All Div.: Russell L. Davies, Dallas, Texas sales representative.

Minneapolis-Honeywell Regulator Company: Wilson R. Coffman, industrial manager of the Wichita, Kansas, branch office.

BullDog Electric Products Company: Robert W. Daleen, field engineer for Kansas area, Wichita, Kansas.

WEST

Minneapolis-Honeywell Regulator Company: Fred B. Akerson, industrial manager of the Portland, Oregon, regional office.

BUSWAY MODERNIZES OLD BUILDING

FROM PAGE 71

ties into the utility's low voltage network and supply transformers. Two double vaults were constructed beneath the sidewalk, each housing a 300 and 500 kva transformer with network protectors. The vaults are designed to accommodate 750 kva transformers if required. The building is served by four main services from these transformer vaults. Each set of service conductors, consisting of four 500 MCM cables per phase, runs through the vault wall and terminates in a current transformer cabinet for utility metering. Current limiters are provided at both ends of each cable. Space is provided for two more cables per phase in each service when and if needed.

The utility CT cabinets were designed as a part of the switchgear. Each service is bussed from the current transformers to individual service switches, one at each end of two pieces of switchgear. The service disconnects are 2500 ampere Pringle bolted pressure switches with high interrupting capacity aluminum alloy fuses. The center sections of the two pieces of switchgear are used for distribution to first floor shops, basement, and dual service to elevator M-G sets, Fig. 9.

From the four service switches four feeders of busway construction, Fig. 6, cross the basement ceiling and enter the abandoned stack shaft where they rise to the 15th floor. At every third floor, the 3rd, 6th, 9th, 12th, and 15th, taps on each riser feed its individual distribution panel containing four 200-ampere knife switches, protected with Amp-Traps, Fig. 10. Each of the four busway runs has a capacity of 2000 amperes to the take-off point at the 9th floor, and 1600 amperes above. A special take-off is installed on all busways above the 15th floor for future elevator feeds. Four distribution panels, each containing four knife switches, provide a total of 16 subfeeder circuits for three floors—four lighting and one power circuit for each floor leaving one switch as a spare.

Tenant Metering

Each floor is divided electrically into quarters with each quarter being fed from one of the main risers through special dual metering cabinets designed to serve from one to four tenants from each section. Two metering cabinets, therefore, are installed on each floor. Thus, sub-feeders from two of the busway risers run to each cabinet where the power is metered before going to the respective lighting branch circuit cabinets. Specially designed terminals ahead of the meters, Fig. 7, permit metering from one to four tenants in a one-quarter section of floor area. Each branch circuit cabinet has four panel sections that can be metered as required for single or multiple occupancy.

Emergency Lighting

Emergency or public lighting for halls, elevators, stairwells and wash rooms, is supplied by two automatic throw-over switches, Fig. 8, located in the basement. One is fed from the A and B busway feeders and the other from C and D. Loss of potential on one of either pair of feeders causes the respective switch to change over to the live one automatically.

Each transfer switch controls a circuit feeding one-half of each floor on all floors, Fig. 10, to provide at least partial lighting on every floor as long as one main service remains energized. Taps are taken off the two risers at every third floor level, similar to the main lighting service, and the individual taps run to two public lighting panels per floor.

The installation is nearing completion and the benefit of detailed engineering has shown its value since no major deviations from the drawings were required during construction. When completed, the Chamber of Commerce Building will have a power and lighting system of the most modern type capable of meeting the requirement of tenants for many years to come. It has plenty of reserve capacity and enough flexibility to take care of additional circuits and tenant changes as needed. The Franklin Electric Construction Co., under the supervision of M. T. Low, is the electrical contractor on this installation.

Suppliers of electrical equipment on this rewiring installation included: busway feeders, cable, conduit, etc.—National Electric Products Corporation; switchgear, panels and cabinets—The Powerlite Switchboard Co; feeder cable current limiters—Burndy Engineering Co., Inc; power distribution and service switches—Pringle Electrical Mfg. Co; public lighting changeover switches—Automatic Switch Co; tenant meters—Sangamo Electric Co; conduit hangers—Grinnell Co; metering cabinet cable lugs—Penn-Union Electric Corp; amp traps and fuses—Chase-Shawmut Co; and current transformers—Westinghouse Electric Corporation.

MARTINDALE GROWLERS

PORTABLE GROWLER TYPE U-2

This Universal Adjustable Growler may be used as both an external Growler for armatures and an internal Growler for stators. It will test armatures from 2" diameter up, and stators from 5¾" diameter up.

ADJUSTABLE BENCH GROWLER

Has adjustable jaws with face length of 2½". With jaws closed will test armatures as small as 1" diameter. With jaws open, will accommodate armatures as large as 18" diameter.

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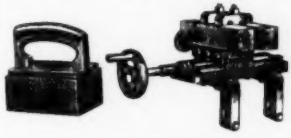

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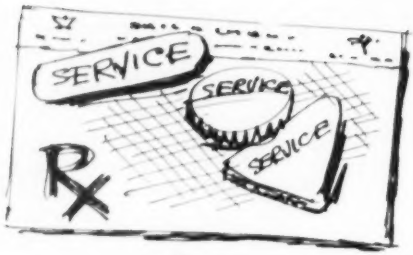

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Having the right answers is the responsibility of every alert wholesaler's salesman. And in order to intelligently handle the wide range of product problems that arise daily, he carefully reviews the advertising pages of ELECTRICAL WHOLESALING for the specific product information he applies to your particular needs.

These are the manufacturers whose advertising in the November issue of ELECTRICAL WHOLESALING strengthened the product services offered by your wholesaler's salesman. The manufacturers, who by keeping your wholesaler's salesman regularly informed, provide the ready cure for "product-itis" . . . and help make your business activities both more profitable and pleasant.

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ELECTRICAL WHOLESALING

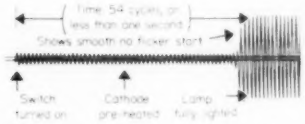
A McGraw-Hill Publication, 330 West 42nd Street, New York 36, N. Y.

RAPID-START FLUORESCENT LIGHTING

[FROM PAGE 73]

luminaires were available providing 45° lengthwise shielding so that students and teachers would not be aware of the brightness of the fluorescent lamps in the luminaires as they worked and studied.

In May of 1952, the General Electric Rapid-Start lamp and ballast circuit was announced at the 4th International Lighting Exposition in


Time: 54 cycles, or less than one second
Shows smooth no flicker start
Switch turned on
Cathode pre-heated
Lamp fully lighted

OSCILLOGRAPH RECORD shows the quick manner in which a Rapid-Start lamp lights after the switch is turned on. Standard preheat-start lamps require up to ten times as long for starting.

Cleveland. When the news of this new quick-starting fluorescent operation was made known to the Wauwatosa school officials, they immediately investigated and made a new study and appraisal of their lighting problems using this new development. This revealed to them the answer to some of the problems they had met with in their earlier fluorescent lighting.

The technical features of the new Rapid-Start circuit were checked with the makers of this new equipment, and the decision was reached to relight 23 rooms of the Lincoln School and 20 rooms of the Jefferson School. The photograph at the top of page 72 shows one of the rooms in the Lincoln School after it was effectively relighted with Rapid-Start. Each room was lighted to an average maintained lighting intensity of 45 footcandles, using three rows of Wakefield Pacemaker Rapid-Start luminaires. These luminaires have 45° lengthwise and 35° crosswise shielding, which provides excellent brightness contrast relations and ideal lighting comfort.

An interesting feature of the relighting is the neat manner in which electrical power was fed to each row of fixtures from one of the old ceiling outlets. Much of the credit for the manner of installation rests with the consulting engineers retained by the Board of Education, Arthur A. Wanty and Associates. The classroom photograph shows how the wires are brought out of an old outlet and fed

(Continued on page 180)

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LONGER WEAR
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RAPID-START FLUORESCENT LIGHTING

(FROM PAGE 179)

across the ceiling to each row of fixtures by the use of surface wiring channel.

Meets IES Standards

This relighting in the Wauwatosa schools is another example where following the American Standard Practice for School Lighting (developed jointly by the Illuminating Engineering Society and the American Standards Association) has resulted in classrooms which are usually comfortable and psychologically cheerful. Ceilings are white acoustical tile. The upper 18 inches of the wall areas are painted white for maximum light reflectivity. The walls are pastel shades with a variance of color from room to room of approximately 60% reflectance. Chalkboards are medium dark green for proper brightness balance with the wall area. Desk tops are blond for more comfortable seeing conditions.

Good Visual Environment

Floors, too, are light so that the areas a student sees as he works at his desk are in brightness balance with the book he is studying. Even tackboards are in the light colors of each wall background. All these features are ones the illuminating engineer recommends for producing a visual environment which is visually efficient and comfortable. The teachers are finding an additional benefit; the children are better disciplined, more eager to cooperate, and are happier in the new light conditioned rooms. The Rapid-Start circuit provided one more progressive step toward greater satisfaction from fluorescent lighting, with quieter operation and with elimination of blinking found in the earlier systems.

Those cooperating in and responsible for this school lighting program and installation of the lighting equipment included: Derral L. Clark, superintendent of schools, and D. J. Clark, assistant superintendent of schools, both of Wauwatosa; Prof. R. C. Putnam, Case Institute of Technology, Cleveland; A. J. Wanty, consulting engineer, Arthur A. Wanty and Associates; B. F. Avery, General Electric Co. lamp engineer; Wm. Heth, F. W. Wakefield Brass Co. representative; J. H. Hausler, G. E. Supply Corp. lighting specialist; and Gene Kasal, S. P. Electric Company, electrical contractors.

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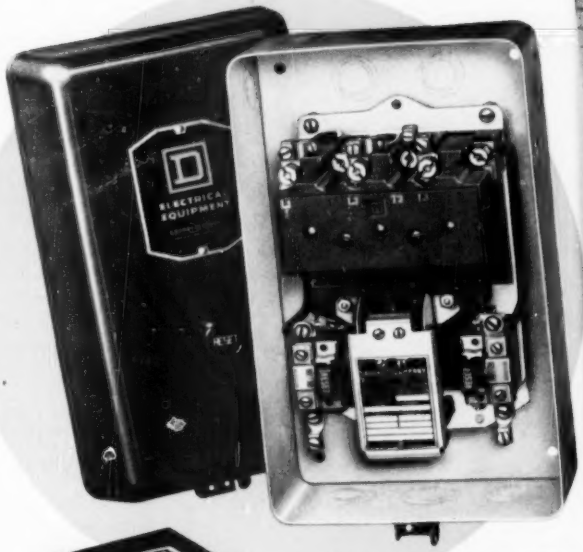

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